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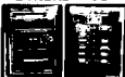
DAVID W TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CE--ETC F/6 15/7  
THE ADVANCED AIRCRAFT DEVELOPMENT PROGRAM (AACDP) BATTLE GROUP --ETC(U)  
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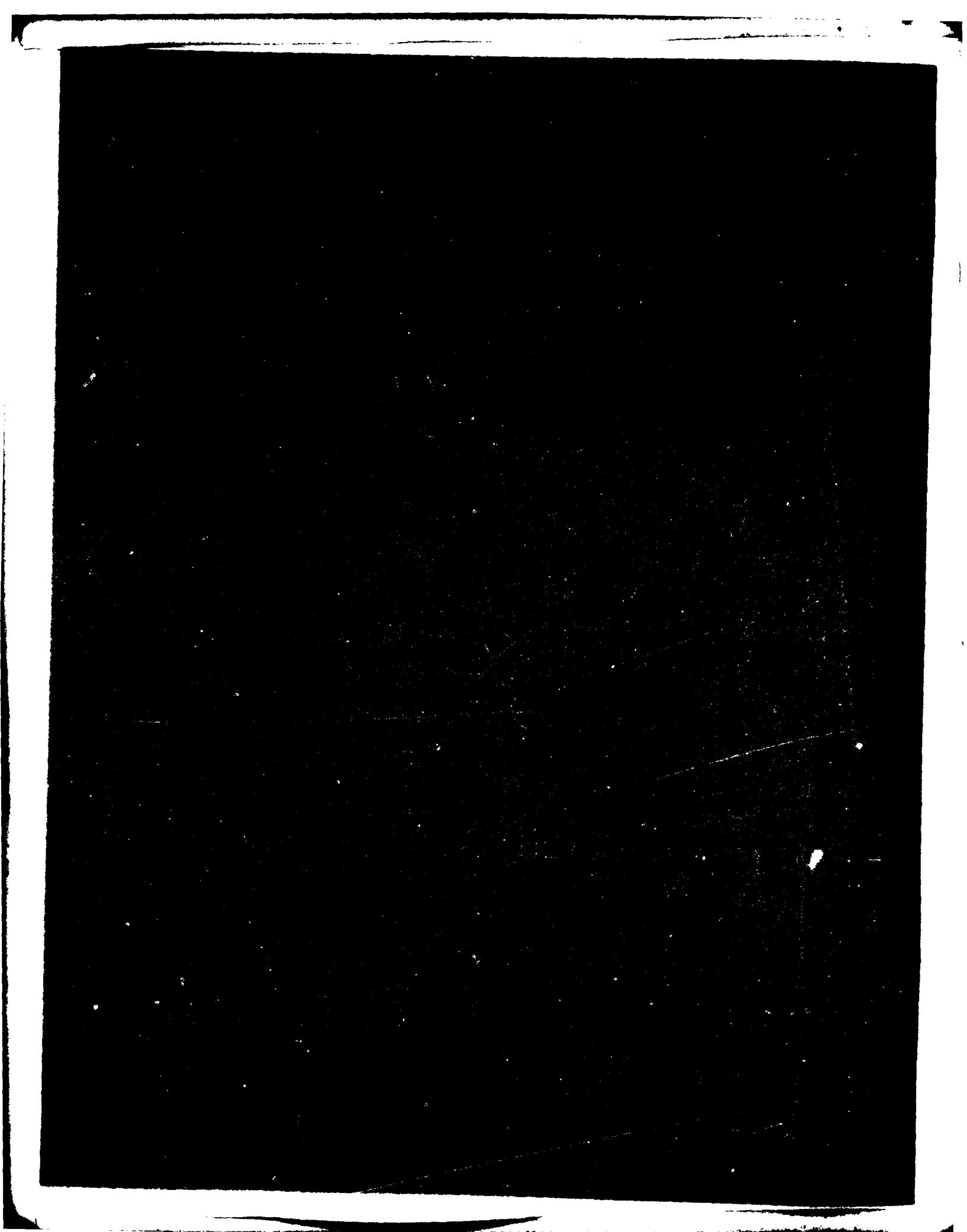
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## EXECUTIVE SUMMARY

### Statement of the Problem

In order to achieve a specific naval military objective (e.g., Sea Control, Convoy) a Battle Group assigned to complete the mission may require a large number of weapons systems. This set of weapons is the Battle Group Combat Suite. Determining the platforms and weapons configurations which make up the Battle Group presents a formidable bookkeeping problem. The problem is further compounded when the Battle Group must be optimal from a platform composition point of view. The objective of this project was to develop an interactive computer program for use in allocating weapons systems to platforms under a set of pre-selected criteria.

### Technical Approach

A mathematical algorithm was developed to distribute the equipment in the Battle Group Combat Suite. This algorithm was designed to minimize both the number of complex ships used and the extra equipment carried by the Battle Group but not specified in the Battle Group Combat Suite. The distribution algorithm was coded in the APL computer language and an interactive computer program system was built around the distribution algorithm. This system allows the user to change the weapons configurations of the available platforms easily, to change the numbers of the various types of available platforms, to outfit new platform types, and to see the effects on the resulting Battle Group.

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## **ABSTRACT**

The Battle Group Combat Suite Distribution routines are interactive computer programs written to support the Advanced Aircraft Carrier Development Program (AACDP). The weapons systems planners and analysts specify, as input to the programs, the Battle Group Combat Suite and the available platforms. The programs provide, as output to the user, an optimal Battle Group chosen from the available platforms which carries the specified Battle Group Combat Suite of weapons. A users manual is provided in addition to the description of the methods employed.

## **ADMINISTRATIVE INFORMATION**

This work was funded by the Systems Development Department (Code 11) of the David W. Taylor Naval Ship Research and Development Center, Bethesda, Maryland 20084. The work was monitored by (Code 1102) under Work Unit 1102-026.

## 1.0 INTRODUCTION

The Advanced Aircraft Carrier Development Program (AACDP) was established several years ago to provide continuing concept development for future air capable platforms. The original plans for the AACDP called for 33 distinct tasks, as shown in the flow chart for the program on the next page, to be performed by various Navy organizations. The Systems Development Department of DTNSRDC was assigned the tasks in blocks 7, 12, and 28. Their objectives were to determine Battle Group Combat Suite/Platform compatibility and to provide a tool for determining Battle Group Candidates. The original idea was that carefully constructed Battle Group Combat Suites would be provided by the organization responsible for block 26 of the flowchart. The task of selecting candidate Battle Group platforms from all the possible platforms appeared to be a problem in optimization, and the Systems Development Department requested support from CMLD in this area. This report documents a computer program developed by CMLD for use in planning the distribution of weapons systems aboard platforms in the context of a Battle Group. Section 2 focuses on the mathematical aspects of the distribution process, Section 3 describes the computer techniques used in the implementation, and Section 4 is a users manual for the computer routines. A supporting input program was also written and is described in Section 4.3.

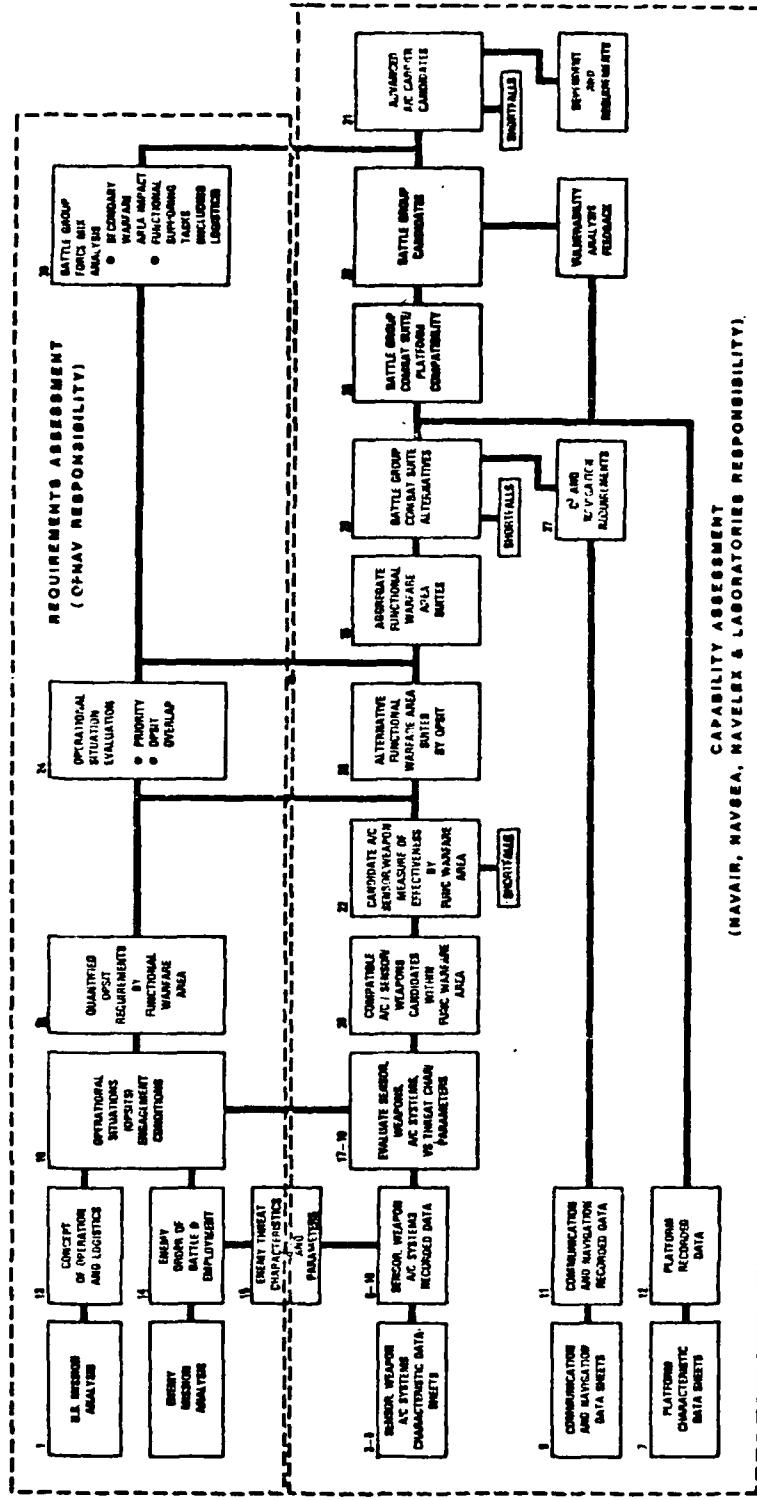


Figure - Advanced Aircraft Carrier Development Program

## 2.0 MATHEMATICAL TECHNIQUES

Modern naval weapons systems consist of three elements: weapons, sensors, and fire control systems. At least 50 separate items make up the weapons systems for modern surface combatant ships alone. Hence, a Battle Group Combat Suite can include on the order of 50 equipment types, with a numerical requirement for each type, and there are currently at least 20 types of major combatant ships. Therefore, to represent mathematically the weapons systems equipment configurations of current combatant vessels requires matrices on the order of 50x20. High speed computers are almost essential for computations involving matrices of this size.

### 2.1 SAMPLE PROBLEM

The allocation algorithm and the procedures used in the computer program will be described with the use of a sample problem:

Analysis of a given mission indicates that it will require five A/A missiles, ten cruise missiles, twelve guns, eighteen mines, and seven torpedoes. The problem is to select, from an armada of available ships, a Battle Group that will contain the least number of expensive ships (the cost of a ship is defined by the total number of weapons it carries) and carry the smallest amount of uncalled for equipment. The available ships consist of cruisers, four submarines, and five frigates, outfitted as follows:

	Cruisers	Submarines	Frigates	
A/A Missiles	1	1	0	
Cruise Missiles	0	2	2	
Guns	2	0	2	
Mines	4	3	0	
Torpedoes	0	2	1	

Thus, submarines are most expensive with eight weapons, cruisers next with seven weapons, and frigates cheapest with only five weapons.

Let  $\underline{a}$  (for "armada") be the 3-element row vector of the number of ships available, and let  $\underline{w}$  (for "weapons suite") be the 5-element row vector of weapons necessary to complete the mission.

$$\begin{aligned}\underline{a} &= (3, 4, 5) \\ \underline{w} &= (5, 10, 12, 18, 7)\end{aligned}$$

Let A (for "array") be the matrix consisting of the ships' configurations.

$$A = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 2 & 2 \\ 2 & 0 & 2 \\ 4 & 3 & 0 \\ 0 & 2 & 1 \end{bmatrix}$$

To determine whether the total armada can do the job, postmultiply A by  $\underline{a}^T$  ( $\underline{a}^T$  is the transpose of  $\underline{a}$ ) to obtain the totals of the five weapons types.

$$A \underline{a}^T = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 2 & 2 \\ 2 & 0 & 2 \\ 4 & 3 & 2 \\ 0 & 2 & 1 \end{bmatrix} \begin{bmatrix} 3 \\ 4 \\ 5 \end{bmatrix} = \begin{bmatrix} 7 \\ 18 \\ 16 \\ 24 \\ 13 \end{bmatrix}$$

Thus, the total armada has enough firepower to accomplish the mission but carries too much excess weaponry.

$$(A \underline{a}^T)^T - \underline{w} = (7, 18, 16, 24, 13) - (5, 10, 12, 18, 7) = (2, 8, 4, 6, 6)$$

The number of some type of vessel in the Battle Group, must be reduced. Submarines are the most expensive ships, so their number is reduced first. The submarine's weapons suite is divided type-by-type into the vector of excess weapons.

$$(2, 8, 4, 6, 6) \div (1, 2, 0, 3, 2) = (2, 4, -, 2, 3)$$

Since the submarines carry no guns, they could all be eliminated without detriment to the gun requirement, but that would result in a shortage of A/A missiles and mines. (Note that division by zero is not defined.)

The vector  $(2, 4, -, 2, 3)$  tells the number of excess submarines with respect to each type of equipment that is, two excess submarines for A/A missiles, four excess for cruise missiles, etc. Eliminating two submarines from the armada leaves a candidate Battle Group of three cruisers, two submarines, and five frigates. The new armada is then  $\underline{a}^* = (3, 2, 5)$ , where the superscript "\*" indicates that this is the next iteration.

$$\text{As before, } A(\underline{a}^*)^T = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 2 & 2 \\ 2 & 0 & 2 \\ 4 & 3 & 2 \\ 0 & 2 & 1 \end{bmatrix} \begin{bmatrix} 3 \\ 2 \\ 5 \end{bmatrix} = \begin{bmatrix} 5 \\ 14 \\ 16 \\ 18 \\ 9 \end{bmatrix}$$

$$\text{and } (A(\underline{a}^*)^T)^T - \underline{w} = (5, 14, 16, 18, 9) - (5, 10, 12, 18, 7) = (0, 4, 4, 0, 2)$$

The candidate Battle Group now carries  $(0, 4, 4, 0, 2)$  excess pieces of equipment. The next most complex (expensive) ships after submarines are cruisers (with 7 weapons), so

$$(0, 4, 4, 0, 2) \div (1, 0, 2, 4, 0) = (0, -, 2, 0, -),$$

thus all the cruisers are needed.

Examining the frigates in like fashion gives

$$(0, 4, 4, 0, 2) \div (0, 2, 2, 0, 1) = (-, 2, 2, -, 2)$$

Clearly, two of the frigates should be deleted, and the final Battle Group is then

$$\underline{a}^{**} = (3, 2, 3).$$

This Battle Group meets the criteria since

$$(A(\underline{a}^{**})^T)^T - \underline{w} = (5, 10, 12, 18, 7) - (5, 10, 12, 18, 7) = 0.$$

## 2.2 FORMAL STATEMENT OF THE PROBLEM

Let  $c = (c_1, \dots, c_n)$  and  $d = (d_1, \dots, d_n)$  be  $n$ -element row vectors of non-negative integers, and let  $A$  be an  $m$  by  $n$  matrix of non-negative integers. If  $c^T$  denotes the transpose of  $c$  (a column vector) and  $x \cdot t^T$  denotes the inner product of  $n$ -element row vectors  $x$  and  $t$ , then the problem is to find an  $n$ -element row vector  $x = (x_1, \dots, x_n)$  that will

$$\text{minimize: } f(x) = x \cdot t^T$$

$$\begin{aligned} \text{subject to: } 1) & Ax^T \geq c^T \\ 2) & 0 \leq x \leq d, \end{aligned}$$

where  $t = (t_1, \dots, t_n)$  is the  $n$ -element vector of column sums of the matrix  $A$ .

## 2.3 FORMAL SOLUTION PROCEDURE

The  $m$  by  $n$  matrix,  $A$ , is the numerical array which carries the information on platform configurations. Each column of  $A$  represents the equipment configuration of a particular platform type, and each row of  $A$  represents the distribution of an equipment type over the various platforms. Thus, there are  $m$  equipment types and  $n$  platform types. The  $n$  element vector  $(t_1, \dots, t_n)$  is the vector of column sums of  $A$ . Each  $t_i$  (for  $i=1, \dots, n$ ) gives the total number of pieces of equipment carried on the  $i^{\text{th}}$  platform type. The Battle Group Combat Suite is given by the  $m$ -vector  $(c_1, \dots, c_m)$ , and the  $n$ -vector  $(d_1, \dots, d_n)$  contains the numbers available for each of the  $n$  platform types.

The problem of minimizing  $(t_1, \dots, t_n) \cdot (x_1, \dots, x_n)^T$ , where " $\cdot$ " denotes inner product, requires finding values for the  $x_i$ 's ( $i=1, \dots, n$ ) which are positive integers and which satisfy

$$A (x_1, \dots, x_n)^T \geq (c_1, \dots, c_m)^T$$

That is, the requirements of the Battle Group Combat Suite  $(c_1, \dots, c_m)$ , must be met or exceeded by the proposed Battle Group  $(x_1, \dots, x_n)$ .

The solution procedure starts with all the available platforms and then removes unnecessary platforms from each of the  $n$  platform types. Initially let  $(x_1, \dots, x_n) = (d_1, \dots, d_n)$ . The next step is to determine whether this element of the feasible set meets the requirements by computing to see if

$$A(x_1, \dots, x_n)^T = A(d_1, \dots, d_n)^T \geq (c_1, \dots, c_m)^T$$

Set  $A(x_1, \dots, x_n)^T - (c_1, \dots, c_m)^T = (b_1, \dots, b_m)^T$

Without loss of generality, we may assume that the columns of  $A$  have been arranged so that the finite sequence of column sums  $t_1, \dots, t_n$ , is non-increasing.

For

$$a_{i1} \neq 0, \quad (i=1, \dots, n) \text{ set } r_i = b_i / a_{i1}.$$

Let  $e_1$  be the minimum of the  $r_i$ 's which are greater than or equal to 1.

Set  $x_1 = d_1 - e_1$ . This procedure is repeated for  $t_2$  through  $t_n$  to give desired result  $(x_1, \dots, x_n)$ .

### 3.0 COMPUTER TECHNIQUES

Since the availability of data for complete weapons systems and Combat Suites was uncertain, a flexible, interactive computer routine was developed incorporating an allocation technique that appeared to have potential utility. This routine requires neither formal training in computer programming languages nor familiarity with computer terminals (see Appendix A). To minimize response time, the computer routines were written in the APL computer language in such a way that data are often redundantly stored in both temporary (local) and permanent (global) files. To systematize and simplify the entry of equipment weights and volumes data, a supporting input program, TIDES (The Interactive Data Entry System), was written in BASIC for the Burroughs B7700 computer.

#### 3.1 HARDWARE

The Battle Group Combat Suite distribution routines for the AACDP were implemented on the Burroughs B7700 computer located at the Carderock, Maryland installation of DTNSRDC. The B7700 is a third generation computer employing virtual memory and emphasizing interactive applications. It is a 48-bit per word machine with two independent Central Processing Units, one Input/Output module, and large disk memory capability. The time sharing user interface to the computer is via commercial phone lines with both 300 and 1200 baud rates supported. Although numerous terminals for the computer are located at the Carderock site, the user need not be on station to use the B7700. Most computer terminals can communicate with the B7700 through an acoustic coupler or MODEM (Modulator-Demodulator). The communication to the B7700 is half-duplex, without parity check. Information concerning the computer facilities at DTNSRDC may be obtained through User Services, Code 1892 (phone (202)227-1907).

#### 3.2 SOFTWARE

##### 3.2.1 APL

The Battle Group Combat Suite distribution routines are written in the computer language APL (A Programming Language). The language differs significantly from most other computer languages in that it is strictly an interactive language with no provision for "batch" programming. In fact, APL does not use

the word "program" to describe computer instructions. Instead one defines "functions" which are then evaluated in the mathematical sense of function evaluation. APL is, in general, mathematically oriented with particular strength in linear algebra. The language, in effect, uses its own alphabet, which includes all the standard English upper-case characters plus about 50 special symbols. Although it is best to have a terminal equipped with the APL character set, the AACDP Battle Group Combat Suite distribution routines are written to accommodate the regular ASCII characters.

### 3.2.2 Functions

The APL workspace AACDWS contains a number of the functions used in the distribution routines in addition to some service functions. One of the duties of the service functions is to call other APL functions from a file named AACDFNS. This use of service (or "cover") functions frees storage area in the workspace for calculations. The distribution functions themselves are fairly complicated and require considerable storage in the active workspace. Since several of the many functions making up the distribution routines are not in constant use, it is unnecessary to keep them in the active workspace. The strategy developed here stores most of the APL functions in the AACDFNS file and fixes them in the active workspace only when they are actually in use. A glossary is provided as Appendix B. Listings of the file functions are given in Appendix C. In addition to the functions which service the file functions, there are several "utility" functions which maintain the active workspace. These functions are helpful in such tasks as conversion of character data to numerical data. To assist in understanding the program flow, flow charts are provided in Appendix D.

### 3.2.3 Data Structures

Three types of data structures are used in the Battle Group Combat Suite distribution routines. Two of these hold numeric data, the other holds character data. The two numeric data structures are vectors and two dimensional arrays (matrices). The character data structure is the character matrix.

Nine data objects are used in the system:

1. Platform Configurations (Numeric Matrix)
2. Battle Group Combat Suite (Numeric Vector)

3. Platform List (Character Matrix)
4. Equipment List (Character Matrix)
5. Platform Numbers (Numeric Vector)
6. Equipment Characteristics (Numeric Matrix)
7. Advanced Platform Characteristics (Numeric Matrix)
8. Advanced Platform List (Character Matrix)
9. Advanced Platform Configurations (Numeric Matrix)

These data objects contain the input data that the distribution routines "edit" and "use". The Equipment Characteristics Matrix is the only matrix which has an input program to aid in data entry. This input program, called TIDES, is discussed in Section 4.3.

Particular care must be exercised in the modification of data structures. For example, the length of the Battle Group Combat Suite vector must be the same as the number of rows of the Platform Configurations Matrix. Refer to the compatibility table for more complete information.

COMPATIBILITY TABLE

Data Object	File Component	Data Type	Dimension	File Components Affected by Modification of Dimension
A, Platform Configuration Matrix	1	Num	m	2,3,4,5,7,10
C, Battle Group Combat Suite	2	Num	m	1,4,7,10
Platform List	3	Char	n x w	1,5,
Equipment List	4	Char	m x v	1,2,7,10
Number of Platforms	5	Num	n	1,3,
Not Used	6	-	-	-
Equipment Characteristics Matrix	7	Num	m x 6	1,2,4,10
Adv. Platforms Char. Matrix	8	Num	k x 2	9
Adv. Platforms List	9	Char	k x u	8
Adv. Platforms Config. Matrix	10	Num	m x k	1,2,4,7,8,9

## 4.0 USER MANUAL

### 4.1 ACCESSING AND LEAVING THE SYSTEM

The following representative procedure is used for gaining access to the system. Although there may be slight differences from what is given here for other terminals, in the main following these instructions will get the user on line (and off again).

1. Turn the terminal on.
2. Set the baud rate (terminal and communication link dependent) and parity.
3. Set the communications link to half-duplex.
4. Dial up the Burroughs B7700 on the data set or phone being used for an acoustic coupler (the number is (202) 227-3300).
5. When the high pitched tone from the computer is heard, punch the data button on the phone or put the receiver in the acoustic coupler.
6. When either garbage or "TYPE <CR>" response is returned to the terminal, hit the carriage return or return button.
7. The computer will respond with a greeting and instruct:  
#ENTER USER CODE PLEASE:
8. In response, type the system command:  
?MCS SYSTEM/APL.  
This will get you into APL.
9. The computer will respond with a greeting.
10. To sign on, type: )ON USERCODE(PASSWORD)CHARGEPCODE  
(Your personal USERCODE, PASSWORD, and CHARGEPCODE are assigned by the computer center.)
11. The computer will return information on the status of your workspace.
12. To start the routines type: )LOAD (USERCODE)AACDWS, then type START.
13. Proceed with the instructions in Paragraph 4.2
14. Hanging up the phone or breaking the communication link will terminate the session.
15. Type o-u-t with the letters overstruck to suspend the session without signing off.
16. To sign off, type:)OFF.
17. Turn off the terminal when finished.

## 4.2 USING THE SYSTEM

### 4.2.1 Starting the Distribution Routines

Once in the workspace AACDWS, the user can begin using the routines stored there. The interactive session is started by typing: START. The system responds by asking whether the user wants to go on. This question is asked because the user will return to this point at various times during the session and, at that time, may not want to go on. To proceed, type: GO. A "menu" of options will be returned.

### 4.2.2 Choosing the Desired Option

The five options are:

1. UPDATE OR VIEW FILE DATA,
2. UPDATE OR VIEW CURRENT LOCAL DATA,
3. ADJUST THE CURRENT PLATFORMS,
4. EXECUTE THE DISTRIBUTION ALGORITHM,
5. NONE OF THE ABOVE.

To pick one of these five options, type the number of with the option. The options are described as follows:

4.2.2.1 Option 1. UPDATE OR VIEW FILE DATA. This option allows the user to see what has been permanently stored on file. There is a distinction between file data and local data. File data refers to more or less permanent information which is the starting point for a session at the terminal. File data can be changed, but the process is intentionally made complicated so that data computed and entered over a period of time will not be inadvertently destroyed. The user is given a list of ten components from which to choose. (Think of a "file" as a drawer in a filing cabinet and a "component" as a folder within that drawer.) The user is asked which folder has the material of interest. After a component is chosen (by typing in the number of that component), the system displays the contents of that component. The information in that component is assigned to a temporary variable in the APL workspace AACDWS named DATA, and the system asks the user if he wants to change any information in DATA. If the answer is NO, the user is again shown the main menu of five options. If the answer is YES (or OUT), the user will exit from the AACD distribution procedure but will still be in the workspace AACDWS and the information

from the chosen component remains in the variable DATA ready to be changed. The variable DATA may be modified by the user using the APL language. The compatibility table (page 12) should be consulted when file changes are made. After the user has changed DATA to suit his needs, the file component remains unchanged. To change the file component the user must write DATA to that file component using the APL/700 command DATA[n] 'AACDFILE', where n is the number of the file component.

4.2.2.2 Option 2. UPDATE OR VIEW CURRENT LOCAL DATA. This choice enables the user to manipulate local data. With this selection the user is immediately presented with another menu of six options.

1. PLATFORM CONFIGURATIONS
2. EQUIPMENT LIST
3. PLATFORM LIST
4. NUMBER OF PLATFORMS
5. BATTLE GROUP COMBAT SUITE
6. NONE OF THESE

Again, the user must choose the data object he wishes to look at, and the routine leads him through the modification procedure.

1. PLATFORM CONFIGURATIONS

Each of the currently available platforms carries certain weapons systems, that is, so many radars of certain types, so many missiles, etc. Most of these configurations are stored in the file, but new platform types may have been added or changes made to the current weapons systems configurations. This option allows the user to look at and change these current weapons systems configurations. For example, the user may want to try a distribution in which all of the available FFG-7 class frigates carry LAMPS III helicopters. The platform configuration matrix is the place to make such a change.

2. EQUIPMENT LIST

The list of equipment types to be distributed is not the same as the Battle Group Combat Suite, which is a list taken from the Equipment List with stated quantities

of each type of equipment. Changing the equipment list is a major step, for such changes affect the platform configuration matrix, the Battle Group Combat Suite and every variable that has anything to do with equipment.  
(Refer to the Compatibility Table.)

### 3. PLATFORM LIST

This option provides a list of the names and quantities of all the platform types which are currently distribution candidates. After viewing the platform list the user is asked if he wants to append a new platform type to the platform list.

### 4. NUMBER OF PLATFORMS

This option allows the user to change the number of platforms of each type available for distribution. The user will be asked to enter the platform number he wants to change and then will be given a chance to change the number of that type of platform available for distribution.

### 5. BATTLE GROUP COMBAT SUITE

This choice allows the user to make changes in the Battle Group Combat Suite. The current Battle Group Combat Suite is displayed and then changes can be made .

### 6. NONE OF THESE

This choice returns the user to the first menu.

4.2.2.3 Option 3. ADJUST THE CURRENT PLATFORMS. This choice allows the user to work with the list and the configurations of platforms currently available for distribution. First, the user is given yet another menu to choose from.

1. INCREASE THE NUMBER OF PLATFORMS
2. ADD AN ADVANCED PLATFORM
3. MODIFY AN EXISTING PLATFORM TYPE
4. OUTFIT A NEW PLATFORM TYPE
5. NONE OF THE ABOVE

The user makes his selection by typing the desired option from the list.

1. INCREASE THE NUMBER OF PLATFORMS

This choice is the same as updating the number of platforms.

2. ADD AN ADVANCED PLATFORM

This choice allows the user to pick a platform configuration from the list of advanced platforms and to insert such a conceptual vessel into the distribution mix with a minimum of effort. He is asked if he knows the advanced platform number if he does not, he is given the list of advanced platforms. After he has selected an advanced platform the file data for that advanced platform is added to the configuration matrix. The updated configuration matrix and updated list of platforms is then available for distribution. He is asked the quantity of these advanced platforms he wants available for distribution. When the user has answered all these questions, he goes back to the original menu.

3. MODIFY AN EXISTING PLATFORM TYPE

This choice is appropriate to retrofit an older platform or to try a different weapons suite on a new type. First, the user enters the platform number of interest; the system displays that platform's current configuration. Next, he enters the desired modifications, putting in the different weapons systems. The modify function updates the configuration matrix and returns the user to the original menu.

4. OUTFIT A NEW PLATFORM TYPE

Here the user can outfit a new platform from the hull up and obtain an estimate of the residual weight and volume. The first question the user must answer is whether the military payload weight and volume are on file. If they are, the system asks for the platform number and fetches the required data. If the payload weight and volume are not on file, the user is asked to name the ship. He then manually enters the payload weight

and volume. At this point (whether starting from scratch or not) the user enters the percentage of weight and volume he actually plans to use. The user decides whether he wants to consider the constraints on weapons systems himself or have the system help him with it. If he wants the constraints considered automatically, the system then asks what equipment type is desired and the number of them to be installed. The program indicates the constraints for the equipment type (i.e., other equipment which must be installed in conjunction with the given equipment) and allows the user to change those constraints. When the user is satisfied with the constraints, the system will compute the number of each associated equipment type which must be installed if the specified number of the desired equipment type is installed and how much payload the weapons systems will take up and subtracts this from the payload weight and volume remaining.

If the user selects the manual instead of the automatic mode for constraint consideration, the system displays the equipment currently on the platform being outfitted and asks the user whether he is finished with that platform. If he is not finished, the user is asked whether he wants to add or delete equipment. To add equipment the user types "A" and the system tells him to enter the equipment number. Next, the user enters the quantity to be added. To delete equipment, he types "D" when prompted and is then asked for the equipment type and the number to be deleted. In either case, the system computes the space and weight committed on the platform. The platform configuration is displayed and the user is again asked if he is finished. If the answer is YES, matrix A is updated and the user is asked how many of this new platform type he wants available for distribution. The user eventually is presented with the original menu.

5. NONE OF THE ABOVE

This option removes the user from the distribution scheme. At just about any point the user can type "OUT" to exit from the system.

4.2.2.4 Option 4. EXECUTE THE DISTRIBUTION ALGORITHM. This is the core of the entire system. The distribution algorithm distributes the equipment in the Battle Combat Group Suite over the available platforms, reducing the number of complex platforms used and keeping the excess equipment carried to a minimum.

When the user chooses this option, he will be asked whether he wants to see the Battle Group Combat Suite. If so, he is asked the same sequence of questions as in UPDATE THE BATTLE GROUP.

After the user has configured the Battle Group the way he desires, he will be asked if he wants to "DISTRIBUTE THE BATTLE GROUP COMBAT SUITE?". If he does he types "YES". (A "NO" answer returns him to the original menu). Now the distribution routine tries to use the platforms the user said were available, in the chosen configurations, to distribute the Battle Group Combat Suite. If enough platforms are available, the final distribution appears and the user is returned to the original menu. (The user can actually see all the various iterations of the algorithm if he assigns the variable SHOW as "SHOWALL" in the AACDWS workspace). If enough platforms are not available, the system provides a summary of the items that were assigned to a platform in the distribution and the user is returned to the menu that allows him to "ADJUST THE CURRENT PLATFORMS". He can make changes in the available platforms and when he is finished, he is again asked if he wants to distribute. After completing his iterations the user can opt to exit, at which point he is returned to the original menu.

4.2.2.5 Option 5. NONE OF THE ABOVE. To end the session the user types "OUT". He is then out of the distribution system, but not off the APL system. To do this, he types "OFF."

4.3 TIDES USERS GUIDE

#### 4.3.1 Introduction to TIDES

TIDES (The Interactive Data Entry System) was written as a data-gathering support program for AACDP (Advanced Aircraft Carrier Development Program) Battle Group Combat Suite Distribution Routines. Written in BASIC this program is a useful tool in the creation and editing of data files that contain weapon specifications. Among the specifications are total system weight, topside weight, below deck weight, total system volume, topside volume, and below deck volume. With its easy-to-use interactive approach, TIDES can be simply run at minimal cost. A sample interactive session is reproduced in Appendix E.

TIDES was developed in response to a need for a simple, quick method for entering weapon specification information into a data file with which the main program could interface and from which it could withdraw the needed information. Appendix F contains the program listing.

#### 4.3.2. Use

After the opening greeting banner, options are available for file editing or file creation.

**4.3.2.1 Specification File Options.** TIDES was designed specifically for editing purposes, but it also provides for creating a file to edit. This is the function of FILE OPTION "1", and once the file is created this option will not be needed. Be careful when entering FILE OPTION not to enter "1" by mistake. An entry in this first option returns a safety check to guard against deleting a previously created file named "TRY." Once the file is set up, there is full compatibility between the file created in option one and the editing of this new file in option two. Because of system restrictions, the name must be internally specified in the program as "TRY."

FILE OPTION "2" is used to edit an already existing file named "TRY". Since data entry and editing are the main function of TIDES, FILE OPTION "2" will be used most often.

**4.3.2.2 Equipment List Options.** The need to interactively create, maintain, and edit an equipment file prompted the creation of equipment list file options. The program poses the question to the user, "Do you already have an equipment list file for the program?" A "YES" response places the user into a mode

from which he can enter his own equipment list (as opposed to using an already existing file) and then continue with the program. The equipment file, either way, must be and is named "EQUIP."

4.3.2.3 Data Entry Options. Once a file named "TRY" exists, it may be edited. TIDES offers eleven options:

Option (1). Print out all the options available to TIDES and their corresponding numbers.

Option (2). Print the list of equipment types and their corresponding numbers.

OPTION (3). Add or delete equipment types to or from "EQUIP". The corresponding characteristics of the equipment types are also added or deleted in the file "TRY" so both files are consistent. The name of an equipment type can also be modified with this option to correct misspellings, etc.

Option (4). Enter the weight (in pounds) and volume (in cubic feet) of a certain equipment type, specified by number.

Option (5). The design of option (5) allows a user who knows only the weight (or only the volume) of an item of equipment, to specify the density of that item. Using the specified density and holding either the weight or volume constant (specified by user), TIDES will compute the volume or weight of an item of equipment from the specified density and a known weight or volume.

Option (6). Using the weight and volume, this option calculates the (corresponding) topside and below deck weights and volumes. The user input is the percentage of the piece of equipment mounted above the main deck (0 level).

Option (7). The actual topside and below deck weights can be entered through option (7). If a total weight has already been specified, a check is made to see if the sum of these weights is consistent with the total weight.

Option (8). Option (8) is the same as option (7) but is calculated in terms of volume.

Option (9). In Option (9), a single line of data is printed out for the equipment number specified.

Option (10). To print out the entire array, option (10) is most useful. It is suggested that the user exercise option (10) prior to the terminate Option (11) to ensure that the updated array is in proper form.

Option (11). Stop the program and save all the results of the editing session into the respective files. This option provides the user exit from TIDES.

APPENDIX A - SAMPLE INTERACTIVE SESSION

LOAD AACDWS  
SAVED 80/08/06 12.52.32

PLATNUMS

- 4- 1. CGN 38-41
- 2- 2. CGN 36,37
- 5- 3. CG 26-34,CGN 35
- 10- 4. CG 16-24,CGN 25
- 17- 5. DDG 47-63
- 10- 6. DDG 37-45
- 4- 7. DDG 993-996
- 10- 8. DDG 15-24
- 12- 9. DDG 3-14
- 6-10. FFG 1-6
- 45-11. FFG 7-15,19-64
- 3-12. DDX
- 31-13. DD 963-992,997
- 46-14. FF 1052-1097
- 10-15. FF 1040CLASS
- 5-16. CUN
- 7-17. CU

EQUIPMENT

1. SPY-1
2. SPS-40
3. SPS-48C
4. SPS-49
5. SPS-55
6. SPS-67
7. MK-23 TAS
8. SQR-18
9. SQR-19
10. SLQ-25 NIXIE
11. SLQ-32(U)2
12. SLQ-32(U)3
13. SOS-53
14. SOS-56 SONAR
15. SSQ-72 OUTBOARD
16. SH-1(MR) MISSILE
17. SH-1(ER) MISSILE
18. SM-2(MR) MISSILE
19. SM-2(ER) MISSILE
20. NSSMS(W/MK-91)
21. SLAT MISSILE
22. HARPOON (4-CELL CANNISTER)
23. HARPOON MISSILE
24. TOMAHAWK (4-CELL CANNISTER)
25. TOMAHAWK MISSILE
26. MK-10 GMLS
27. MK-13 GMLS
28. MK-11 GMLS
29. MK-16 GMLS
30. MK-36 DECOY LS
31. EX-41 VLS
32. MK-26 GMLS
33. MK-15 CIWS
34. MK-42 5 IN. GUN
35. MK-45 5 IN. GUN
36. MCLWG 8 IN. GUN
37. MK-75 76MM GUN
38. MK-32 TORP. TUBE
39. ASROC
40. MK-68 GFCSW(GIP MODS)
41. MK-74 GMFCS
42. MK-76 GMFCS
43. MK-86 GMFCS
44. MK-92 GMFCS
45. MK-99 GMFCS
46. SEAFIRE
47. A-6 INTRUDER
48. S-3 VIKING
49. E-2C HAWKEYE
50. F-14 TOMCAT
51. F-18 HORNET
52. AV-8B SEAHARRIER
53. SH-3 SEA KING
54. LAMPS I
55. LAMPS III

START  
THIS WORKSPACE CONTAINS ROUTINES WHICH DISTRIBUTE  
WEAPONS SYSTEMS AND SENSORS OF A BATTLE GROUP COMBAT  
SUITE OVER COMPATIBLE PLATFORMS.  
IF YOU WISH TO CONTINUE ON, TYPE: GO. OTHER-  
WISE, TYPE: OUT.

GO

FROM THE FOLLOWING LIST CHOOSE THE  
OPTION YOU WANT AND TYPE THAT NUMBER:

1. UPDATE OR VIEW FILE DATA
2. UPDATE OR VIEW CURRENT LOCAL DATA
3. ADJUST THE CURRENT PLATFORMS
4. EXECUTE THE DISTRIBUTION ALGORITHM
5. NONE OF THE ABOVE

4  
WOULD YOU LIKE THE PRESENT BATTLE GROUP  
COMBAT SUITE DISPLAYED?  
YES

NOTE: OUTPUT IS ON NEXT PAGE

3- 1.	SPY-1	0-38.	MK-32 TORP. TUBE
0- 2.	SPS-40	40-39.	ASROC
2- 3.	SPS-48C	0-40.	MK-68 GFCS(W/ GIP MODS)
1- 4.	SPS-49	4-41.	MK-74 GMFCS
0- 5.	SPS-55	1-42.	MK-76 GMFCS
0- 6.	SPS-67	2-43.	MK-86 GMFCS
0- 7.	MK-23 TAS	0-44.	MK-92 GMFCS
1- 8.	SQR-18	4-45.	MK-99 GMFCS
3- 9.	SQR-19	0-46.	SEAFIRE
0-10.	SLQ-25 NIXIE	12-47.	A-6 INTRUDER
3-11.	SLQ-32(U)2	20-48.	S-3 VIKING
2-12.	SLQ-32(U)3	8-49.	E-2C HAWKEYE
2-13.	SQS-53	48-50.	F-14 TOMCAT
3-14.	SQS-56 SONAR	96-51.	F-18. HORNET
0-15.	SSO-72 OUTBOARD	0-52.	AV-8B SEAHARRIER
45-16.	SM-1(MR) MISSILE	16-53.	SH-3 SEA KING
202-17.	SM-1(ER) MISSILE	0-54.	LAMPS I
302-18.	SM-2(MR) MISSILE	5-55.	LAMPS III
690-19.	SM-2(ER) MISSILE	<u>DO YOU WISH TO MAKE ANY CHANGES?</u>	
4-20.	NSSMS(W/ MK-91)	<u>NO</u>	
20-21.	SLAT MISSILE	<u>DO YOU WISH TO DISTRIBUTE THE PRESENT BAT</u>	
8-22.	HARPOON (4-CELL CANNISTER)	<u>TLE GROUP</u>	
94-23.	HARPOON MISSILE	<u>COMBAT SUITE?</u>	
0-24.	TOMAHAWK (4-CELL CANNISTER)	<u>YES</u>	
16-25.	TOMAHAWK MISSILE		
2-26.	MK-10 GMLS	<u>NOTE: OUTPUT IS ON NEXT PAGE</u>	
0-27.	MK-13 GMLS		
0-28.	MK-11 GMLS		
1-29.	MK-16 GMLS		
0-30.	MK-36 DECOY LS		
4-31.	EX-41 ULS		
5-32.	MK-26 GMLS		
11-33.	MK-15 CIWS		
4-34.	MK-42 5 IN. GUN		
0-35.	MK-45 5 IN. GUN		
0-36.	MCLWG 6 IN. GUN		
1-37.	MK-75 76MM GUN		

THERE ARE NOT ENOUGH PLATFORMS OF THE RIGHT  
CONFIGURATIONS TO DISTRIBUTE ALL OF THE  
REQUIRED EQUIPMENT.  
THE FOLLOWING EQUIPMENT CANNOT BE ACCOMODATED.  
1130 19. SM-2(ER) MISSILE

THIS IS THE DISTRIBUTION:

1.	CGN	38-41
2.	CGN	36,37
3.	CG	26-34, CGN 35
4.	CG	16-24, CGN 25
5.	DDG	47-63
6.	DDG	37-45
7.	DDG	993-996
8.	DDG	15-24
9.	DDG	3-14
10.	FFG	1-6
11.	FFG	7-15, 19-64
12.	DDX	
13.	DD	963-992, 997
14.	FF	1052-1097
15.	FF	1040CLASS
16.	CUN	
17.	CU	

FROM THE FOLLOWING LIST, CHOOSE THE NUMBER  
OF THE OPTION YOU WISH TO EXERCISE:

1. INCREASE QUANTITY OF A PLATFORM TYPE.
2. ADD AN ADU. PLATFORM TYPE FROM THE FILE.
3. MODIFY AN EXISTING PLATFORM TYPE.
4. OUTFIT NEW A PLATFORM.
5. NONE OF THE ABOVE.

ARE THE PAYLOAD WEIGHT AND VOLUME ON FILE FOR THE  
PLATFORM YOU PROPOSE TO OUTFIT?  
NO

ENTER THE NAME OF THE NEW PLATFORM YOU WANT OUTFITTED.

18. MISSILE FRIGATE  
ENTER THE MILITARY PAYLOAD OF THE PLATFORM YOU WANT TO  
OUTFIT. FIRST GIVE THE WEIGHT IN POUNDS. THEN THE  
VOLUME IN CUBIC FEET.

1000000 1000000  
ENTER AS AN ORDERED PAIR, THE PERCENT OF THE PAYLOAD  
WEIGHT AND THE PERCENT OF THE PAYLOAD VOLUME TO BE  
UTILIZED IN OUTFITTING THIS PLATFORM.

90 80  
ARE WEAPONS SYSTEMS CONSTRAINTS TO BE  
CONSIDERED AUTOMATICALLY?

YES

19. WHAT EQUIPMENT NUMBER DO YOU WANT ABOARD?

19  
HOW MANY OF THESE DO YOU WANT?

40

HERE ARE THE WEAPON SYSTEM CONSTRAINTS:

1 - 1. SPY-1  
52-19. SM-2(ER) MISSILE

1-31. EX-41 ULS

4-45. MK-99 GMFCS

DO YOU WISH TO MODIFY THESE CONSTRAINTS?  
NO

HERE IS THE WEAPON SYSTEM IMPLIED:

1 - 1. SPY-1  
52-19. SM-2(ER) MISSILE

1-31. EX-41 ULS

4-45. MK-99 GMFCS

THERE ARE 489476 POUNDS OF PAYLOAD LEFT.  
THERE ARE 74658 CUBIC FEET OF PAYLOAD LEFT.  
18. MISSILE FRIGATE

1 - 1. SPY-1  
52-19. SM-2(ER) MISSILE

1-31. EX-41 ULS

4-45. MK-99 GMFCS

ARE YOU FINISHED WITH THIS PLATFORM?

YES HOW MANY OF THESE NEWLY OUTFITTED PLATFORMS  
DO YOU WANT AVAILABLE FOR DISTRIBUTION?

2

WOULD YOU LIKE THE PRESENT BATTLE GROUP  
COMBAT SUITE DISPLAYED?

NO

DO YOU WISH TO MAKE ANY CHANGES?

NO

DO YOU WISH TO DISTRIBUTE THE PRESENT BATTLE GROUP  
COMBAT SUITE?

YES

NOTE: OUTPUT IS ON NEXT PAGE

THERE ARE NOT ENOUGH PLATFORMS OF THE RIGHT  
CONFIGURATIONS TO DISTRIBUTE ALL OF THE  
REQUIRED EQUIPMENT.  
THE FOLLOWING EQUIPMENT CANNOT BE ACCOMODATED.  
26 19. SM-2(ER) MISSILE

THIS IS THE DISTRIBUTION:

- 4 1. CGN 38-41
  - 2 2. CGN 36,37
  - 5 3. CG 26-34,CGN 35
  - 10 4. CG 16-24,CGN 25
  - 0 5. DDG 47-63
  - 10 6. DDG 37-45
  - 0 7. DDG 993-996
  - 0 8. DDG 15-24
  - 0 9. DDG 3-14
  - 0 10. FFG 1-6
  - 13 11. FFG 7-15,19-64
  - 2 12. DDX
  - 4 13. DD 963-992,997
  - 1 14. FF 1052-1097
  - 0 15. FF 1040CLASS
  - 2 16. CUN
  - 1 17. CU
  - 2 18. MISSILE FRIGATE
- FROM THE FOLLOWING LIST, CHOOSE THE NUMBER  
OF THE OPTION YOU WISH TO EXERCISE:
- 1. INCREASE QUANTITY OF A PLATFORM TYPE.
  - 2. ADD AN ADU. PLATFORM TYPE FROM THE FILE.
  - 3. MODIFY AN EXISTING PLATFORM TYPE.
  - 4. OUTFIT NEW A PLATFORM.
  - 5. NONE OF THE ABOVE.

ARE THE PAYLOAD WEIGHT AND VOLUME ON FILE FOR THE PLATFORM YOU PROPOSE TO OUTFIT?

YES

DO YOU KNOW THE NUMBER OF THE PLATFORM YOU WANT?

NO

HERE IS THE LIST OF ADV. PLATFORMS:

101. SES FRIGATE

102. SWATH FRIGATE

103. CVU

104. SWATH FLATTOP

WHICH PLATFORM DO YOU WANT?

102

102. SWATH FRIGATE  
ENTER. AS AN ORDERED PAIR, THE PERCENT OF THE PAYLOAD  
WEIGHT AND THE PERCENT OF THE PAYLOAD VOLUME TO BE  
UTILIZED IN OUTFITTING THIS PLATFORM.

90 90

ARE WEAPONS SYSTEMS CONSTRAINTS TO BE  
CONSIDERED AUTOMATICALLY?

NO

102. SWATH FRIGATE  
ARE YOU FINISHED WITH THIS PLATFORM?

NO

DO YOU WANT TO ADD OR TO DELETE  
EQUIPMENT? (ANSWER: A OR D)

A

WHICH EQUIPMENT NUMBER DO YOU WANT ABOARD?

19

HOW MANY OF THESE DO YOU WANT?

10

THERE ARE 90130 POUNDS OF PAYLOAD LEFT.  
THERE ARE 10130 CUBIC FEET OF PAYLOAD LEFT.

102. SWATH FRIGATE

10-19. SH-2(ER) MISSILE

ARE YOU FINISHED WITH THIS PLATFORM?

YES

HOW MANY OF THESE NEWLY OUTFITTED PLATFORMS  
DO YOU WANT AVAILABLE FOR DISTRIBUTION?

3  
WOULD YOU LIKE THE PRESENT BATTLE GROUP  
COMBAT SUITE DISPLAYED?

NO

DO YOU WISH TO MAKE ANY CHANGES?

NO

DO YOU WISH TO DISTRIBUTE THE PRESENT BATTLE GROUP  
COMBAT SUITE?  
YES

NOTE: OUTPUT IS ON NEXT PAGE

**THIS IS THE DISTRIBUTION:**

- 4 1. CGN 38-41
- 2 2. CGN 36,37
- 5 3. CG 26-34,CGN 35
- 10 4. CG 16-24,CGN 25
- 0 5. DDG 47-63
- 10 6. DDG 37-45
- 0 7. DDG 993-996
- 0 8. DDG 15-24
- 0 9. DDG 3-14
- 0 10. FFG 1-6
- 13 11. FFG 7-15,19-64
- 2 12. DDX
- 4 13. DD 963-992,997
- 1 14. FF 1052-1097
- 0 15. FF 1040CLASS
- 2 16. CUN
- 1 17. CU
- 2 18. MISSILE FRIGATE
- 3 102. SWATH FRIGATE

FROM THE FOLLOWING LIST CHOOSE THE  
OPTION YOU WANT AND TYPE THAT NUMBER:

- 1. UPDATE OR VIEW FILE DATA
- 2. UPDATE OR VIEW CURRENT LOCAL DATA
- 3. ADJUST THE CURRENT PLATFORMS
- 4. EXECUTE THE DISTRIBUTION ALGORITHM
- 5. NONE OF THE ABOVE

EXCESS  
THERE ARE: 4053 EXTRA PIECES OF EQUIPMENT  
WHICH ARE USED IN THIS DISTRIBUTION.  
THEY ARE:

1- 1.	SPY-1	12-34.	MK-42	5 IN.	GUN
5- 2.	SPS-40	16-35.	MK-45	5 IN.	GUN
33- 3.	SPS-48C	4-36.	MCL/HG	8 IN.	GUN
43- 4.	SPS-49	64-37.	MK-75	76MM	GUN
23- 5.	SPS-55	102-38.	MK-32	TORP.	TUBE
28- 6.	SPS-67	288-39.	ASROC		
4- 7.	MK-23 TAS				
0- 8.	SQR-18	21-40.	MK-68	GFC'S(W/ GIP MODES)	
14- 9.	SQR-19	8-41.	MK-74	GMFCS	
49-10.	SLQ-25 NIXIE	49-42.	MK-76	GMFCS	
17-11.	SLQ-32(U)2	14-43.	MK-86	GMFCS	
29-12.	SLQ-32(U)3	13-44.	MK-92	GMFCS	
8-13.	SQS-53	12-45.	MK-99	GMFCS	
10-14.	SQS-56 SONAR	6-46.	SEAFIRE		
15-15.	SSQ-72 OUTBOARD	15-47.	A-6 INTRUDER		
1075-16.	SM-1(MR) MISSILE	8-48.	S-3 VIKING		
6-17.	SM-1(ER) MISSILE	1-49.	E-2C HAWKEYE		
818-18.	SM-2(MR) MISSILE	47-50.	F-14 TOMCAT		
4-19.	SM-2(ER) MISSILE	13-51.	F-18. HORNET		
0-20.	NSSMS(W/ MK-91)	30-52.	AU-8B SEAHARRIER		
0-21.	SLAT MISSILE	1-53.	SH-3 SEA KING		
260-22.	HARPOON (4-CELL CANNISTER)	14-54.	LAMPS I		
174-23.	HARPOON MISSILE	37-55.	LAMPS III		
96-24.	TOMAHAWK (4-CELL CANNISTER)	)OFF	THURSDAY	12 MARCH 1981	1:46 PM
80-25.	TOMAHAWK MISSILE		TIMES:	SESSION	TO DATE
33-26.	MK-10 GMLS		CONNECT	0.21.16	87.53.04
12-27.	MK-13 GMLS		CPU	0.00.13	0.31.51
13-28.	MK-11 GMLS		IO	0.00.02	0.09.58
327-29.	MK-16 GMLS				
14-30.	MK-36 DECOY LS				
22-31.	EX-41 ULS				
7-32.	MK-26 GMLS				
58-33.	MK-15 CIWS				

NOTE: THIS SESSION WAS DONE ON  
A TEKTRONIX 4015-1 TERMINAL.

## APPENDIX B GLOSSARY

### FUNCTIONS (Resident in workspace)

APPEND - Appends a character matrix variable named LIST with more rows of character data. The resultant character matrix is called NEWLIST.

CALL - Calls a function from the file and fixes it in the active workspace

CLOSE - Closes a CANDE file which was previously opened by the function OPEN.

CONFIG - Shows the current weapon suite (i.e., configuration) of one of the platforms available for distribution.

CONVERT - Converts character data to numerical data for processing.

COPY - Copies a CANDE file.

FDISPLAY - Serially displays the contents of a specified APL file.

FIX - Fixes an APL function stored in a file into the active workspace.

OPEN - Opens a CANDE file from the APL workspace.

PACK - Removes the blank spaces from a character input.

PAD - Pads the end of a line of character data with blank spaces so the line can be appended to an existing character matrix.

PLATNUMS - Displays the current number of platforms of each class available for distribution.

READ - Reads the contents of a CANDE file opened previously.

RESET - Resets the workspace when it is necessary to start over but to keep the changes made.

ROWNAMES - Produces a padded character matrix from a character vector input in which the rows are determined by user-selected delimiters.

START - Starts the distribution routine and makes the initial file function call.

STICK - Places the output of the function COPY into a numerical vector.

STRIP - Strips the leading blanks from a character vector input.

WRITE - Writes information onto a previously opened CANDE file.

#### FILE FUNCTIONS

ADD1 - Adds an advanced platform from the Advanced Platform List (Component 8, AACDFILE) to the list of platforms available for distribution.

ADJUST - Initiates the procedures for making adjustments to the platforms list and the configurations matrix.

AGGREGATE - Totals the weight and volume of a specified weapons system by referring to the Equipment Characteristics Matrix in Component 7 of the AACDFILE.

AGG1 - Pulls data from the Equipment Characteristics Matix (Component 7, AACDFILE).

BATTLEGROUP - Facilitates the user's desired modification of the Battle Group Combat Suite.

CHECK - Checks the weapons system constraints automatically and allows their modification.

COMMAND - Presents the main selection of user options.

COMPSYS - Computes and displays the weapons system implied in the automatic constraint consideration mode of ADJUST.

DISPLAY - Displays the weapons systems suite of the platform after the adjustments have been made.

DISTRIBUTE - This is the main distribution algorithm and is described in detail elsewhere in this report.

ENTER - Allows interactive choice for update of file components in the AACDFILE.

EXECUTE - Calls and executes various other funcitons in the file.

INCREASE1 - Increases the number of any platform available for distribution.

INSTALL - Carries out the arithmetic associated with installation of equipment on a platform; i.e., the weight and volume available on a platform type reduced by the equipment weight and volume stored in the characteristics matrix.

MODIFY - Modifies the weapons configuration of a platform type.

OUTFIT1 - This is the heart of the modification procedure, it allows the user to identify the bare hull and that hull's capacities.

SUBMIT1 - A short function which allows entry of an equipment type.

SUBMIT2 - Allows the user to specify unwanted equipment.

UP1 - Appends equipment to a list.

UPDATE - Updates the various file components.

### VARIABLES

A - Configurations matrix.  
AACDFILEMAP - List of the components of the file AACDFILE.  
BGCS - Battle Group Combat Suite vector.  
C - Temporary dimension vector.  
EQUIPMENT - Equipment list.  
FLAG - Flag test variable.  
FLAG1 - Flag test variable.  
FNMAP - File map for the file functions.  
LIST - Temporary character matrix used in APPEND.  
NEWLIST - Temporary character matrix output of APPENDD.  
NUMBERPLATS - Vector of numbers of platforms available.  
PAYLOAD - Temporary vector used in ADJUST.  
PLAT - Temporary character matrix used in ADJUST.  
PLATFORMS - Platforms available for distribution.  
REGALIA - Temporary vector of weapons configurations used in ADJUST.  
SHORT - Shortfalls (if any) after the distribution.  
SHOW - Control variable for indicating whether intermediate steps in the distribution are to be shown.  
SOLN - Solution vector for the distribution.  
TEXT - Temporary variable of character data.  
WEAPON - Temporary scalar used in ADJUST.  
XS - Excess weaponry carried.

### FILES

AACDFNS - Functions used or called in the workspace AACDWS.  
AACDFILE - Permanent data used by the distribution routines.

### OTHER

APL - Acronym for A Programming Language  
AACDWS - Name of the APL workspace in which distribution routines are located.  
CANDE - Acronym for the Burroughs "Command AND Edit" interactive system.

**APPENDIX C - FUNCTION LISTINGS**

## RESIDENT FUNCTIONS

```

    ♦APPEND[0]♦
    ♦ APPEND LIST+DELIM+ENTRY
    [1] NEWLIST+LISTA PUT LIST INTO NEWLIST.
    [2] TO EXIT THIS FUNCTION: HIT RETURN.
    [3] START: ENTER NAME TO BE APPENDED.
    [4] ENTRY+@N USER INPUT PLACED IN ENTRY.
    [5] DIM+NEWLISTA PUT THE SHAPE OF NEWLIST INTO VARIABLE DIM.
    [6] +0+10+PENTRY+ EXIT IF THE ENTRY IS A RETURN.
    [7] DELIM+((1+DIM),1)+\A SHAPE A COLUMN OF THE DELIMITER \ FOR PREFIXING L
    ISt.
    [8] NEWLIST+DELIM.[2]NEWLISTA PLACE LEADING \ ON EVERY NAME IN LIST.
    [9] NEWLIST+NEWLIST.\,ENTRY\ CATENATE THE NEW ENTRY ONTO THE LIST.
    [10] NEWLIST+NEWLIST+(10)ROWNAMES NEWLISTA RESHAPE THE LIST USING THE FUNCTIO
    N ROWNAMES.
    [11] +START

    ♦CALL[0]♦
    ♦ CALL FN:MAP
    [1] MAP+((1+FNMAP),FN)+FNMAP
    [2] +OUT+\^0+MAP+,MAP\,-@FN
    [3] DFXB[MAP,1].ACDFNS;
    [4] JFN
    [5] QEX FN
    [6] +0
    [7] OUT: 'THE FUNCTION ',FN,' COULD NOT BE FOUND.'
    [8] +0

    ♦CLOSE[0]♦
    ♦ CLOSE
    [1] OSUR 2 2+C1D1

```

```

▼ CONFIG[0]▼
  ▼ CONFIG PLATNUM; IND
    PLATFORMS(PLATNUM; )
    IND+(A[PLATNUM]>0); ^1^A
    (T@ALIND;PLATNUM); . ; EQUIPMENT[IND]; }

▼ CONVERT[0]▼
  ▼ NUMBER+CONVERT INPUT
    START:~OUT~\~'OUT';~INPUT
    +BADx10~INPUT
    +BADx1~INPUT~INPUT~'0123456789'
    NUMBER~INPUT
    +0
    BAD; 'IMPROPER INPUT. ENTER NUMERICAL '
    DATA OR ~'OUT'~.
    INPUT~STRIP
    START
    OUT;NUMBER+10
    FLAG+0
    +0

▼ COPY[0]▼
  ▼ COPY;I;@;F;C1;D1;T
    I=0
    @~INPUT FILE NAME?
    +(0~OPEN i?~@~OPENOK
    @~ERROR IN FILE NAME.
    OPENOK: +(0~T~READ I)~ERROR
    OUTPUT~OUTPUT.D1
    I+=1
    +OPENOK
    ERROR:~(10~T)~DONE
    @~ERROR IN FILE READ.
    DONE~CLOSE

```

```

    ♦EXCESS(0)♦
    ♦ EXCESS
    [1] 'THERE ARE: ' ;XS; ' EXTRA PIECES OF EQUIPMENT '
    [2] 'WHICH ARE USED IN THIS DISTRIBUTION.'
    [3] 'THEY ARE:
    [4] (T(A. *SOLN) -C), ' ;, EQUIPMENT

    ♦FDISPLAY(0)♦
    ♦ FDISPLAY F;N;J
    [1] BF
    [2] F
    [3] N+1N++/BF
    [4] J+0
    [5] GO:D+J+J+1
    [6] B[J]F
    [7] DL
    [8] +GOx1J+1/N
    [9] BF
    [10] +0

    ♦FLIX(0)♦
    ♦ FIX FN;MAP
    [1] MAP+((1↑FNMAP).P FN)↑FNMAP
    [2] +OUTx1^/0-MAP+.MAPA.-@FN
    [3] DFXB[MAP11].AACDFNS;
    [4] +0
    [5] OUT; 'THE FUNCTION ' .FN, ' COULD NOT BE FOUND. '
    [6] +0

    ♦HELP(0)♦
    ♦ HELP
    [1] 'YOU NEED HELP, PLEASE SEEK ASSISTANCE. '

```

```

    ♦OPEN[0]♦
    ♦ ERR+OPEN FILENAME
      'FILEUTIL'OSUO 2 2+C1D1'
    [1]   1 OSUC'C1'
    [2]
    [3] C1+FILENAME
    [4] ERR+C1

    ♦PACK[0]♦
    ♦ PACKED+PACK TEXT
      PACKED+(TEXT',')/TEXT
    [1]   ♦
    [2]

    ♦PAD[0]♦
    ♦ R+LIST PAD LINE;NUM
      NUM+(1+LIST)-L((1+PLIST),LINE
    [1]   R+LINE,NUM,
    [2]   R+LINE,NUM,`

    ♦PLATNUMS[0]♦
    ♦ PLATNUMS
      Q+(TNUMBERPLATS),`..,PLATFORMS
    [1]   [1]
    [2]   Q+(TNUMBERPLATS),`..,PLATFORMS

    ♦READ[0]♦
    ♦ ERR+READ RECORDNO
      C1+0,RECORDNO
    [1]   ERR+C1
    [2]

    ♦RESET[0]♦
    ♦ RESET
      DEX FNMAP
    [1]   ♦

```

```

▼ Z+S ROWNAMES T;A;B;R
[1] B+T+1+T+,T
[2] A+(+/-B)+B
[3] R+T/A+((1+A,(?1)+PT)-1+A
[4] Z+((?A),R)+((A..2(?1)+,R)\(~B)/T
[5] R+PZ
[6] +BY+R+..#S+2+(2*x3 2+(P,S),0=-1+S)+((-2+0,S),R,-R)(2 3 2 3 2 1 2 5 0 1 0 5+?1
]
[7] BY:Z+(S*x1 -1*xS)+Z
[8] +OUTx0, -1+S
[9] OUT:Z+(1-(2.. ' ))+I+PZ

▼ START[]▼
▼ START;TEXT
[1] 'THIS WORKSPACE CONTAINS ROUTINES WHICH DISTRIBUTE'
[2] 'WEAPONS SYSTEMS AND SENSORS OF A BATTLE GROUP COMBAT'
[3] 'SUITE OVER COMPATIBLE PLATFORMS.'
[4] INST:'IF YOU WISH TO CONTINUE ON, TYPE: GO. OTHER-'
[5] 'WISE, TYPE: OUT.'
[6] TEXT+STRIP TEXT+@REMOVE LEADING BLANKS FROM USER INPUT
[7] +0*x1~/(3+TEXT)='OUT'@TEST FOR EXIT OF FUNCTION
[8] +OK*x1~/(2+TEXT)='GO'@TEST FOR GO AHEAD
[9] 'YOUR INPUT WAS NOT IN PROPER FORM.'
[10] +INST
[11] OK:CALL 'COMMAND'

▼ STICK[]▼
▼ STICK
[1] @THIS FN STICKS THE OUTPUT OF COPY INTO A NUMERICAL VECTOR NUMOUT.
[2] LOOP:NUMOUT~NUMOUT,1810+OUTPUT
[3] OUTPUT+@10+OUTPUT
[4] +(0=+OUTPUT)/0
[5] +LOOP

```

```
    ♦ STRIP[0]♦
    ♦ R+STRIP A
    ♦ R+(`,-`,"A")11)A
[1]   ♦
    ♦ WRITE[0]♦
    ♦ ERR+DATA WRITE RECORDNO
[1]     D1+DATA
[2]     C1+1.RECORDNO
[3]     ERR+C1
[4]
```

## FILE FUNCTIONS

```
B[1]'AACDFNS'
ADD1;NEWPLAT;ADUCON;REPLY
ADUON+BI[10]'AACDFILE'
'DO YOU KNOW THE NUMBER OF THE ADVANCED'
'PLATFORM DESIRED?'
YES+'Y'+1'REPLY+STRIP0
NO+'N'+1'REPLY
INVALID RESPONSE!
+0
NO:'THIS IS THE LIST OF ADVANCED PLATFORMS:'
B[9]'AACDFILE'
YES:'WHAT IS THE NUMBER OF THE ADVANCED'
'PLATFORM YOU WANT ADDED?'
REPLY+100+0
NEWPLAT+,ADUON1;REPLY]
A+A,NEWPLAT
NEWPLAT+(B[9]'AACDFILE')[REPLY]
PLATFORMS+PLATFORMS,[1]PLATFORMS PAD NEWPLAT
'HOW MANY OF THESE DO YOU WANT TO DISTRIBUTE?'
NUMBERPLATS+NUMBERPLATS,0
+0
```

```

CALL 'INSTALL'
MANUAL:CALL 'DISPLAY'
'ARE YOU FINISHED WITH THIS PLATFORM? '
'DONE'+'Y'-'1'+'0
'SUBMIT'+'FLAG1'-'1
'DO YOU WANT TO ADD OR TO DELETE? '
'EQUIPMENT?'+'ANSWER:A OR D'
'DELETE'+'D'-'1'+'0
CALL 'SUBMIT1'
R+WEAPON

'AGG
DELETE:CALL 'SUBMIT2'
R+WEAPON
R+(( ('1'+'PR')*2 ), 2 )+'PR
CALL 'AGG1'
CALL 'INSTALL'
'MANUAL
DONE:'+'A',REGALIA
PLATFORMS+PLATFORMS,11PLATFORMS PAD P
LAT
'HOW MANY OF THESE NEWLY OUTFITTED PLA
TFORMS? '
'DO YOU WANT AVAILABLE FOR DISTRIBUTIO
N? '
NUMBERPLATS+NUMBERPLATS,CONVERT@
'0
MODIFY:CALL 'MODIFY1'
'0
OUT:FLAG+'0
'0

'CONSIDERED AUTOMATICALLY? '
FLAG1+'0
REGALIA+'1',PA)'+'0
'MANUAL'+'N'-'1'+'0
FLAG1+'1
SUBMIT:CALL 'SUBMIT1'
CALL 'CHECK'
AGG:CALL 'AGGREGATE'

```

OUT: +0  
 BAD: 'YOUR RESPONSE WAS NOT IN THE  
     'PROPER FORM.'  
 →FIRST  
 FIRST  
 DISP: (10,C), '-' EQUIPMENT  
 QUERY: 'DO YOU WISH TO MAKE ANY CHANGES?  
 REPLY+STRIP@  
 →OUT x 1^/ 'OUT' - 3↑REPLY  
 →CHANGE x 1^/ 'Y' - 1↑REPLY  
 →0

B[3]'AACDFNS'  
 AGGREGATE;EQVOL;EQWT;EQCHAR  
 EQCHAR+B[7]'AACDFILE'  
 →TWO x 1^/ 'R  
 ONE: EQWT+•/R[1;2]×EQCHAR[R[1;1];1]  
 EQOL+•/R[1;2]×EQCHAR[R[1;1];4]  
 WEAPONSYS-EQWT;EQVOL  
 →0  
 TWO: R+1 2↑R  
 →ONE

B[4]'AACDFNS'  
 AGG1:EQCHAR  
 EQCHAR+B[7]'AACDFILE'  
 WEAPONSYS+WEAPON[1]×EQCHAR[WEAPON[1];1 4]

B[5]'AACDFNS'  
 BATTLEGROUP;REPLY;SHAPE  
 FIRST: 'WOULD YOU LIKE THE PRESENT BATTLE GROUP,  
     'COMBAT SUITE DISPLAYED?  
 REPLY+STRIP@  
 →OUT x 1^/ 'OUT' - 3↑REPLY  
 →DISP x 1^/ 'Y' - 1↑REPLY  
 →QUERY  
 CHANGE: 'ENTER THE CHANGES DESIRED IN THE BATTLE'  
 GROUP COMBAT SUITE AS A LIST OF ORDERED'  
 'PAIRS: THE FIRST ENTRY IN EACH PAIR IS,  
     'THE EQUIPMENT TYPE NUMBER, THE SECOND,  
     'IS HOW MANY OF THE TYPE ARE NEEDED.  
 REPLY+0  
 →OUT x 1^/ 'OUT' - 3↑REPLY  
 →BAD x 1^/REPLY@ .0123456789  
 REPLY+REPLY  
 SHAPE+P,REPLY  
 REPLY+((SHAPE+2),2)↑REPLY  
 CIREPLY[1]-REPLY[2]  
 →FIRST

8[6]'AACDFNS'

CHECK  
'HERE ARE THE WEAPON SYSTEM CONSTRAINTS:'  
CONS-B[100+WEAPON[1]]'AACDFILE'  
+NONE x:0=1',CONS  
DISP:(T,CONS[;2]),'-' EQUIPMENT[CONS[;1]];]  
MODIFY: 'DO YOU WISH TO MODIFY THESE CONSTRAINTS?'  
+YES x:1'Y'=1+@  
R+CONS  
+NOCONS x:10=1',CONS  
CALL 'COMPSYS'  
+0  
YES: 'ENTER THE NEW CONSTRAINTS AS A SEQUENCE'  
'OF ORDERED PAIRS. THE FIRST ELEMENT IN'  
'EACH PAIR SHOULD BE THE EQUIPMENT NUMBER'  
'AND THE SECOND ELEMENT SHOULD BE HOW MANY'  
'OF THAT TYPE ARE IN THE WEAPON SYSTEM.'  
CONS+CONVERT INPUT+@  
+0x10=FLAG  
+NONE x:0=1',CONS  
CONS+((T,CONS)+2),2)'CONS  
'YOU HAVE SELECTED THE FOLLOWING WEAPON SYSTEM.'  
+DISP  
BAD: 'BE SURE TO ENTER DATA AS DIRECTED.'  
+YES  
NONE: 'THERE ARE NO WEAPON SYSTEM CONSTRAINTS.'  
+MOD  
NOCONS: R+1 2'WEAPON  
+0

B(7)'AACDFNS'

COMMAND: TEXT

FLAG=1

START: 'FROM THE FOLLOWING LIST CHOOSE THE  
'OPTION YOU WANT AND TYPE THAT NUMBER:  
'1. UPDATE OR VIEW FILE DATA'  
'2. UPDATE OR VIEW CURRENT LOCAL DATA'  
'3. ADJUST THE CURRENT PLATFORMS '  
'4. EXECUTE THE DISTRIBUTION ALGORITHM'  
'5. NONE OF THE ABOVE'  
TEXT~~STRIP TEXT~~  
→OUT~~x 1~\`OUT`~3`TEXT~~  
TEXT~~+1`TEXT~~  
→BAD~~x 0~\`TEXT`~12345`~~  
→ENT~~x `TEXT`~1`~~  
→UP~~x `TEXT`~2`~~  
→ADJ~~x `TEXT`~3`~~  
→EXE~~x `TEXT`~4`~~  
→OUT~~x `TEXT`~5`~~  
BAD: 'INPUT-NOT-IN-PROPER-FORM'  
→START  
ENT:CALL 'ENTER'  
→0~~x`IFLAG=0`~~  
→START  
UP:CALL 'UPDATE'  
→0~~x`IFLAG=0`~~  
→START  
ADJ:CALL 'ADJUST'  
→0~~x`IFLAG=0`~~  
→START  
EXE:CALL 'EXECUTE'  
→0~~x`IFLAG=0`~~  
→START  
OUT:~~→0~~

B[8]'AACDFNS'  
COMPSYS|NUMBER  
'HERE IS THE WEAPON SYSTEM IMPLIED:  
NUMBER+WEAPON[2]+(WEAPON[1]-R[;1])/R[;2]  
R[;2]+NUMBER×R[;2]  
(T|R[;2]),'--',EQUIPMENT|R[;1];]  
  
B[9]'AACDFNS'  
DISPLAY;IND  
PLAT  
IND+(REGALIA^0)/11PA  
(TREGALIA[IND]),'--',EQUIPMENT[IND;]

```

    >0      @([10]'ACDFNS,
        DISTRIBUT:EQUIPTOTS:IND:COEFFS:I:GRAD
        E:INDEX:Differences:NONZERO:RATIO
        ;OBJEVAL
        SOLN:NUMBERPLATSMAKE FIRST GUESS
        SHORT+0
        >START*1~'C1,EQUIPTOTS+A..x@SOLN@CHECK
        TO SEE IF ALL OF THE EQUIPMENT I
        S ALLOCATED BY THE FIRST GUESS.
        SHORT+C-EQUIPTOTS FIND THE SHORTFAL
        LS.
        SHORT*SHORT*SHORT+0 PLACE ZEROS IN T
        HE NOT SHORT POSITIONS.
        THERE ARE NOT ENOUGH PLATFORMS OF THE
        RIGHT.
        CONFIGURATIONS TO DISTRIBUTE ALL OF T
        HE '
        REQUIRED EQUIPMENT.
        THE FOLLOWING EQUIPMENT CANNOT BE ACC
        OMODATED.
        IND+1,SHORT+0)/10.SHORT FIND THE I
        NDICES OF THE SHORTFALLS.
        (TSHORT:IND:1).-1.EQUIPMENT:IND:1
        DISPLAY THE LIST OF SHORTFALLS.
        C+C-SHORT REDUCE THE REQUIRED EQUIP
        MENT VECTOR BY THE SHORTFALLS SO
        THE SORT WILL GO.
        START:COEFFS+0/[1]ANSETS COEFFICIENTS
        OF THE OBJECTIVE FUNCTIONS.
        I+1INITIALIZES THE SENSITIVE VARIABLE
        INDEX.
        GRADE+1COEFFS RANKS THE COEFFS IN DECR
        EASING ORDER.
        NEXT:INDEX+GRADE+1 PICK THE NEXT LARG
        EST COEFFICIENT.
        EQUIPTOTS,A..x@SOLN@RECOMPUTE THE EQU
        IPMENT TOTALS

```

DIFFERENCES-EQUIPTOTS-C FIND THE DIFFE  
RENCE BETWEEN THE NUMBER OF EACH  
TYPE OF EQUIPMENT ALLOCATED AND  
THE NUMBER REQUIRED.

NONZERO+0@AL:INDEX)@FIND NONZERO ENTR  
IES OF SENSITIVE VARIABLE'S EQUIP  
MENT.

+INCR\*x:1,RATIO+1/(NONZERO/,DIFFERENCES  
)@NONZERO@AL:INDEX)@FIND THE RATI  
OS BETWEEN THE DIFFERENCES AND TH  
E NONZERO ENTRIES OF THE SENSITIV  
E VARIABLE.

SOLN(INDEX)+SOLN(INDEX)-RATIO@REDUCE  
THE SENSITIVE VARIABLE BY TRUNCAT  
ED SMALLEST RATIO.

SOLN(INDEX)+0@SOLN(INDEX)@DON'T REDUCE  
THE NUMBER OF SHIPS LESS THAN 2E  
RO

OBJEVAL+\*/COEFFS\*SOLN@EVALUATES THE OB  
JECTIVE FUNCTION AT THE CURRENT S  
OLUTION.

+INCR\*x:1,(?SHOW)@SHOWALL@ PUT IN A  
N OVERRIDE SO THAT DISTRIBUTION P  
ROCESS MAY BE VIEWED.

THE CURRENT DISTRIBUTION IS: ' :SOLN@D  
ISPLAY THE CURRENT DISTRIBUTION.  
THERE ARE: ' ;OBJEVAL-+/,C; ' EXTRA PIE  
CES OF EQUIPMENT WHICH ARE USED I  
N THIS DISTRIBUTION.

INCR:I+1+1@INCREMENT THE COUNTER  
OUT\*x:1,NUMBERPLATS@CHECK TO SEE IF A  
LL VARIABLES HAVE BEEN REDUCED.

+NEXT@ITERATE SOME MORE  
OUT:DL

THIS IS THE DISTRIBUTION:  
(T@SOLN), ' ,PLATFORMS@DISPLAY THE FIN  
AL DISTRIBUTION  
XS-OBJEVAL-+/,C

```

B[11]'AACDFNS'
ENTER:TEXT
GO: 'CHOOSE THE NUMBER CORRESPONDING TO THE
'FILE COMPONENT THAT YOU WANT TO VIEW
'OR UPDATE:
SHOW:AACDFILEMAP
+OUT:1^/'OUT'-'3+TEXT+0
+BADx:0= PTEXT
+BADx:1~~/TEXT' '0123456789 '
'HERE IS THE DATA IN THAT COMPONENT.
'DATA+B[1TEXT1'AACDFILE'
DO YOU WISH TO CHANGE THIS DATA?
YESx:1'Y'-'1+0
DEX'DATA'
+0
YES: 'THIS DATA IS ASSIGNED TO THE VARIABLE
'DATA. YOU MAY MODIFY THE VARIABLE DATA,
'AND THEN STORE THIS BACK INTO THE CORRECT
'FILE COMPONENT.
+0
OUT:FLAG+0
+0
BAD: 'PLEASE ENTER THE NUMBER OF A FILE
'COMPONENT, OR TYPE ''OUT''.
SHOW

```

```

B(12)'AACDFNS'
EXECUTE:REPLY;REMARK;SHAPE
FIRST:CALL 'BATTLEGROUP'
START: 'DO YOU WISH TO DISTRIBUTE THE PRESENT BATTLE GROUP,
'COMBAT SUITE?
REPLY+STRIP@
+OUT+1+`OUT'-3+REPLY
+DISTx1`Y'-1+REPLY
+0x1`N'-1+REPLY
`ANSWER YES. NO. OR OUT.
+START
DIST:BGCS+C
CALL 'DISTRIBUTE'
+FITx10+.,SHORT
+0
FIT:CALL 'ADJUST'
C+BGCS
+FIRST
OUT:FLAG+0
+0

```

```

B(13)'AACDFNS'
INCREASE1:RESP;ANS
`WHAT IS THE PLATFORM NUMBER?
RESP+10+1`0123456789`ISTRIP@
+NUMx1`RESP,0)^RESP+1+A
`YOU DID NOT ENTER THE NUMBER OF A PLATFORM
`TYPE WHICH IS ALREADY A DISTRIBUTION
`CANDIDATE.
+0
NUM: `THE PLATFORM IN QUESTION IS: `PLATFORMS[RESP];
`THERE ARE CURRENTLY `NUMBERPLATS[RESP]; `OF THESE PLATFORMS
`AS DISTRIBUTION CANDIDATES. HOW MANY
`OF THESE DO YOU WANT?
ANS+10+1`0123456789`ISTRIP@
NUMBERPLATS[RESP]+ANS
+0

```

```

B[14]'AACDFNS'.
INSTALL;LEFT
LEFT+PAYLOAD-WEAPONSYS
*SHORTx10,L/LEFT
PAYLOAD+LEFT
REGALIAIR[1]+R[2]
'THERE ARE ':PAYLOAD[1];' POUNDS OF PA
YLOAD LEFT.
'THERE ARE ':PAYLOAD[2];' CUBIC FEET O
F PAYLOAD LEFT.
*0
SHORT:'THERE IS NOT ENOUGH PAYLOAD LEF
T TO BRING'
'THIS SYSTEM ABOARD.
DEX'THREE'
B[15]'AACDFNS'.
MODIFY1:REPLY:MODS
START:'FROM THE FOLLOWING LIST. CHOOSE
THE NUMBER'.
'OF THE PLATFORM YOU WISH TO MODIFY:
PLATFORMS
REPLY+0
*OUTx1:0+-1^REPLY
*BAD1x10+PREPLY
*BAD1x1^-^/REPLY+'0123456789 '
REPLY+REPLYS('A')[2]
'YOU FAILED TO ENTER THE NUMBER OF A P
LATFROM.
LISTED ABOVE. TYPE ''OUT'' IF YOU HA
NT TO EXIT.
*0x1:0+-1^0
*START
NUM:'YOU HAVE CHOSEN TO MODIFY: PLA
TFORMS[REPLY];
'THE CURRENT CONFIGURATION IS: '

```

```

    *OUT*x1'0'*1'R
    *BADINPUT*x1~~/R*0123456789 '
    R+R

OUTFIT:ANS:R
START:'ARE THE PAYLOAD WEIGHT AND VOLU
ME ON FILE FOR THE'
'PLATFORM YOU PROPOSE TO OUTFIT?'
ANS+1'STRIP@
+YESx1'Y'ANS
+NO2x1'N'ANS
*OUT*x1'0'*ANS
'PLEASE ANSWER YES, NO, OR OUT.'
*START
YES:'DO YOU KNOW THE NUMBER OF THE PLA
TFORM YOU WANT?'
*START
ANS+1'STRIP@
+NOPEx1'N'ANS
PICK:'WHICH PLATFORM DO YOU WANT?'
ANS+@BADIN*x1~~/ANS*0123456789 '
ANS+4ANS
*BADIN*x1ANS:100
ANS+100+ANS
0*PLAT*(B[9]'AACDFILE')(ANS;)
R*(B[8]'AACDFILE')(ANS;)
+NO1
NOPE:'HERE IS THE LIST OF ADV. PLATFOR
MS: '
B[9]'AACDFILE'
*PICK
NO2:'ENTER THE NAME OF THE NEW PLATFOR
M YOU WANT OUTFITTED.'
PLAT+@
NO:'ENTER THE MILITARY PAYLOAD OF THE
PLATFORM YOU WANT TO'
'OUTFIT. FIRST GIVE THE WEIGHT IN POU
NDS, THEN THE'
'VOLUME IN CUBIC FEET.'
R+@

```

```

B(17)'AACDFNS'
SUBMIT1:WEAPON2
START:'WHICH EQUIPMENT NUMBER DO YOU WANT ABOARD?'
WEAPON+@  

→BAD x 1 ~ ~/WEAPON+ '0123456789  

WEAPON+WEAPON  

→BAD x 1 ~ ~/WEAPON+ '11' EQUIPMENT  

'HOW MANY OF THESE DO YOU WANT?  

WEAPON2+@  

→BAD x 1 ~ ~/WEAPON2+ '0123456789  

WEAPON2+WEAPON2  

WEAPON+WEAPON,WEAPON2  

→0  

BAD: 'YOU DID NOT ENTER A LEGITIMATE EQUIPMENT NUMBER.  

+START

B(18)'AACDFNS'
SUBMIT2:WEAPON2
START:'WHICH EQUIPMENT NUMBER DO YOU WANT THROWN?  

OVERBOARD?  

WEAPON+@  

→BAD x 1 ~ ~/WEAPON+ '0123456789  

WEAPON+WEAPON  

→BAD x 1 ~ ~/WEAPON+ '11' EQUIPMENT  

MANY: 'HOW MANY OF THESE DO YOU WANT PITCHED?  

WEAPON2+@  

→BAD x 1 ~ ~/WEAPON2+ '0123456789  

WEAPON+WEAPON,-WEAPON2  

→BAD2+WEAPON[2] '-REGALIA[WEAPON[1]]  

→0  

BAD: 'YOU DID NOT ENTER A LEGITIMATE  

'EQUIPMENT NUMBER.  

+START
BAD2: 'YOU DON'T HAVE THAT MANY ABOARD.  

+START

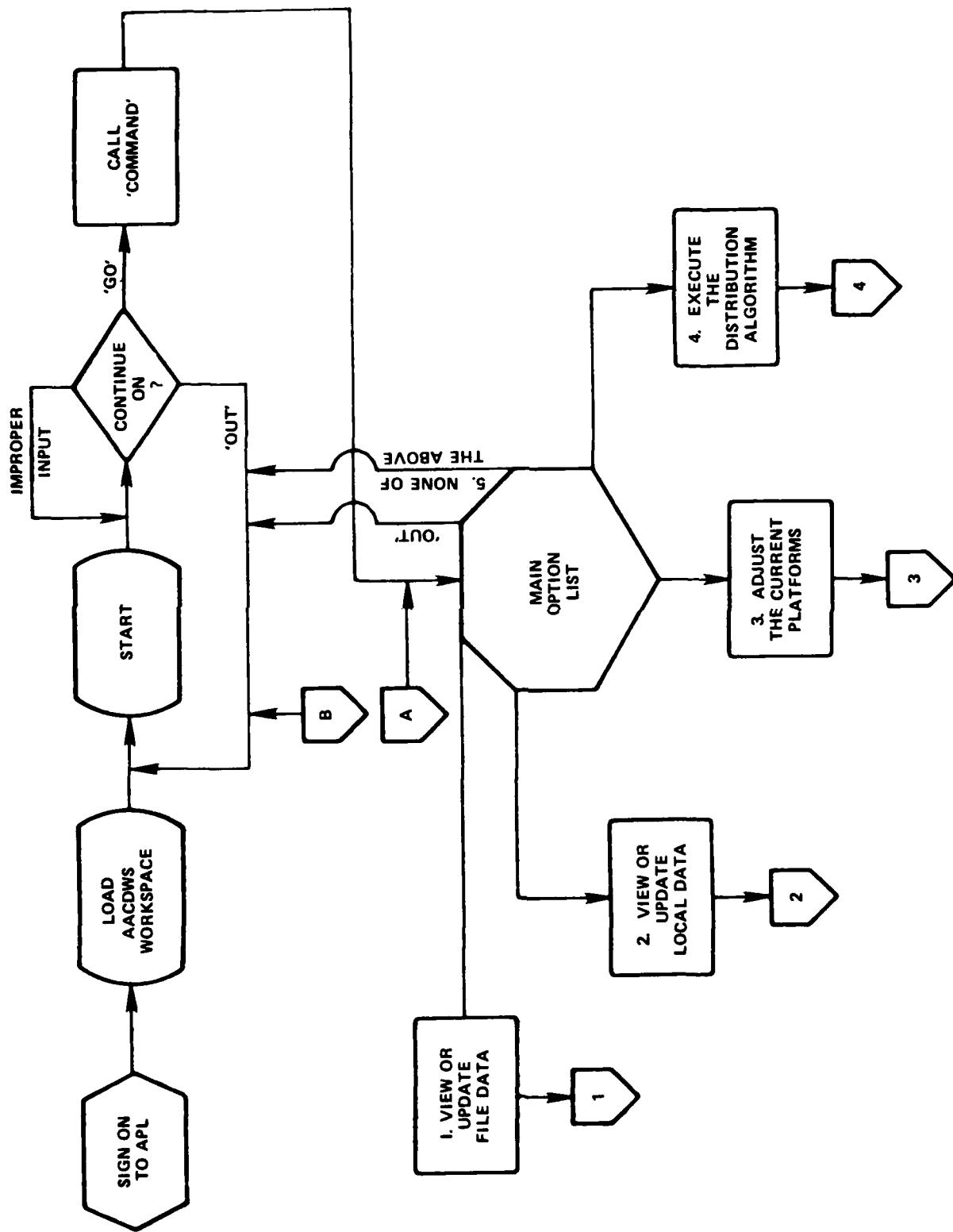
```

```
CALL 'UP1'
UP1
  START
    AACDFNS!
    LIST
      DO YOU WANT TO APPEND THIS LIST?
      YESx1.Y+1+0
      +0
      YES:APPEND LIST
      LIST+NEWLIST
      +0

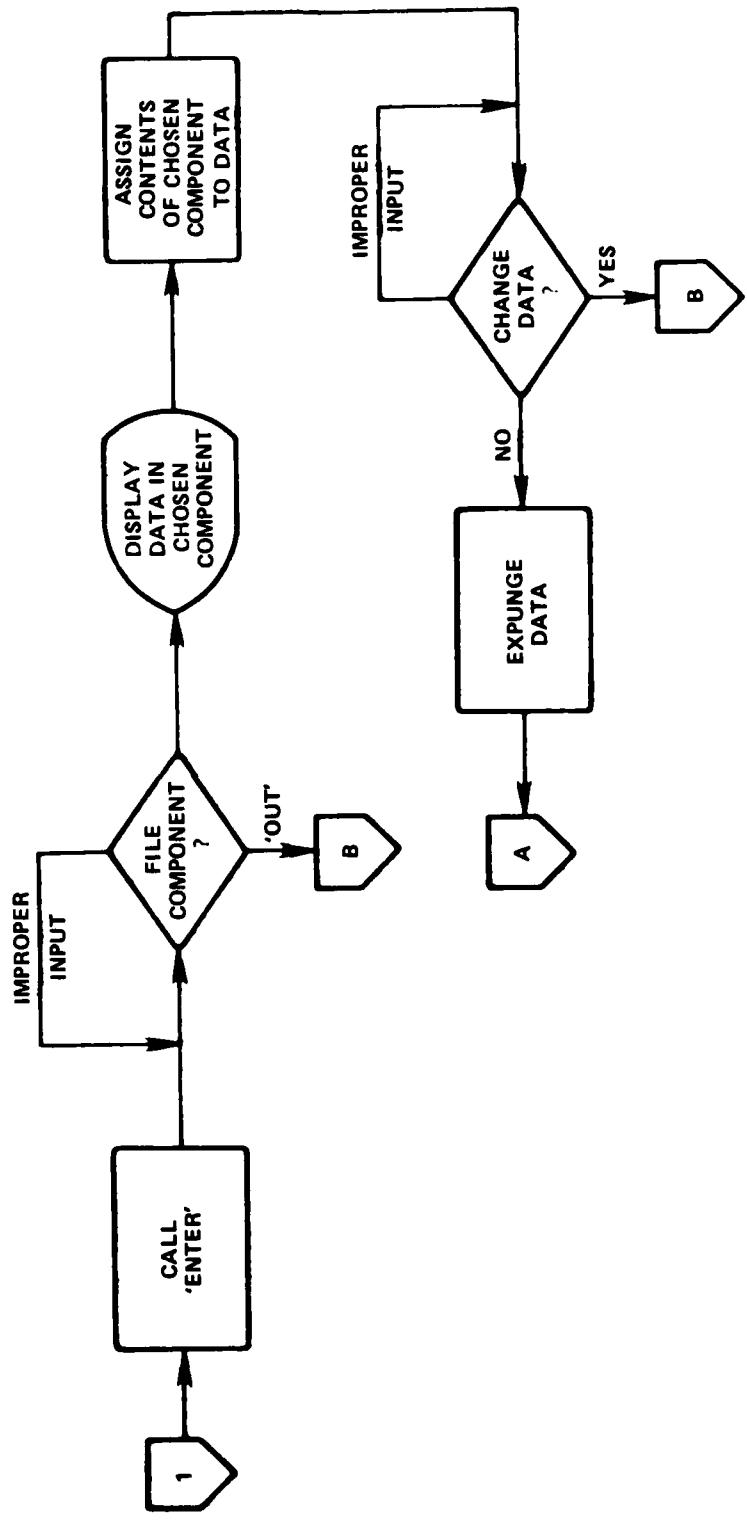
    AACDFNS!
    CALL 'UP1'
    THREE:LIST+PLATFORMS
    CALL 'UP1'
    FOUR:CALL 'INCREASE1'
    +START
    FIVE:CALL 'BATTLEGROUP'
    +START
    LIST+START
```

```
B(19) AACDFNS!
UPDATE;REPLY
START:FROM THE FOLLOWING LIST, CHOOSE THE OBJECT!
THAT YOU WISH TO VIEW OR UPDATE:
1. PLATFORM CONFIGURATION
2. EQUIPMENT LIST
3. PLATFORM LIST
4. NUMBER OF PLATFORMS
5. BATTLE GROUP COMBAT SUITE
6. NONE OF THESE
REPLY+STRIP REPLY+0
+OUT+1+/OUT+3+REPLY
REPLY+1+REPLY
BAD+0+/REPLY=123456+
ONE+REPLY=1+
TWO+REPLY=2+
THREE+REPLY=3+
FOUR+REPLY=4+
FIVE+REPLY=5+
0+REPLY=6+
OUT:FLAG+0
+0
BAD:YOUR REPLY COULD NOT BE EVALUATED.
+START
ONE:CALL 'MODIFY1'
+START
TWO:LIST+EQUIPMENT
```

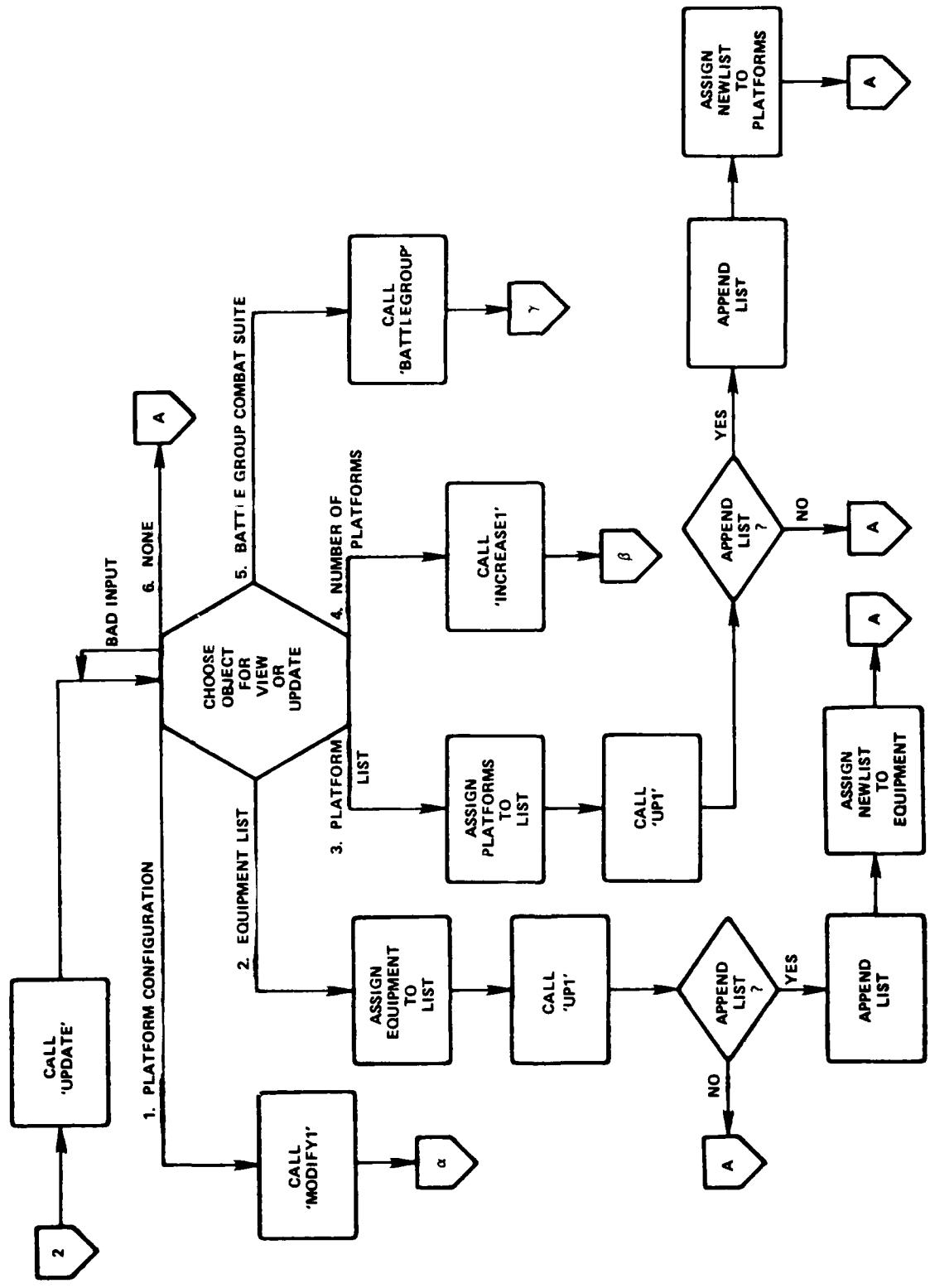
**APPENDIX D - FLOW CHARTS**

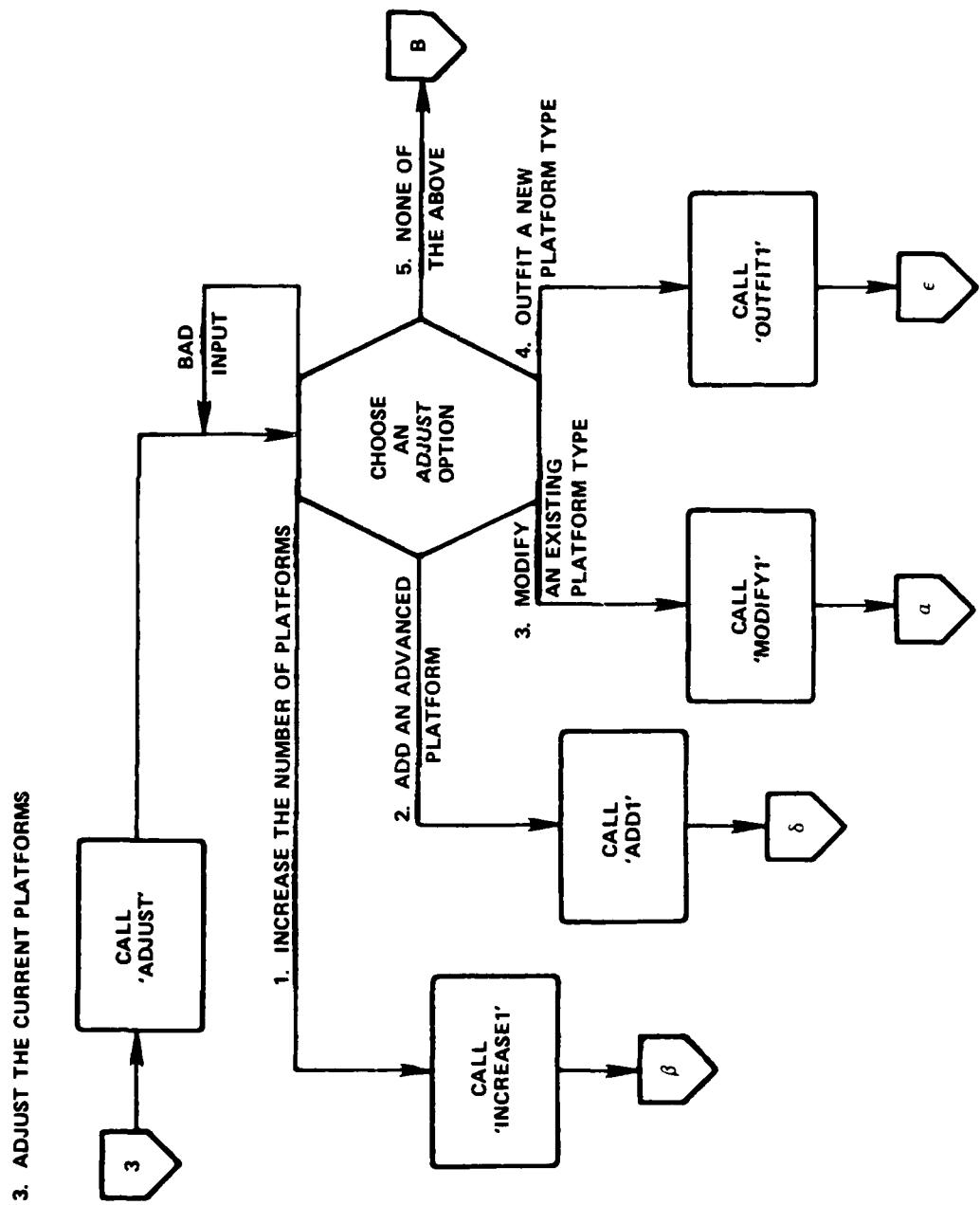


1. VIEW OR UPDATE FILE DATA

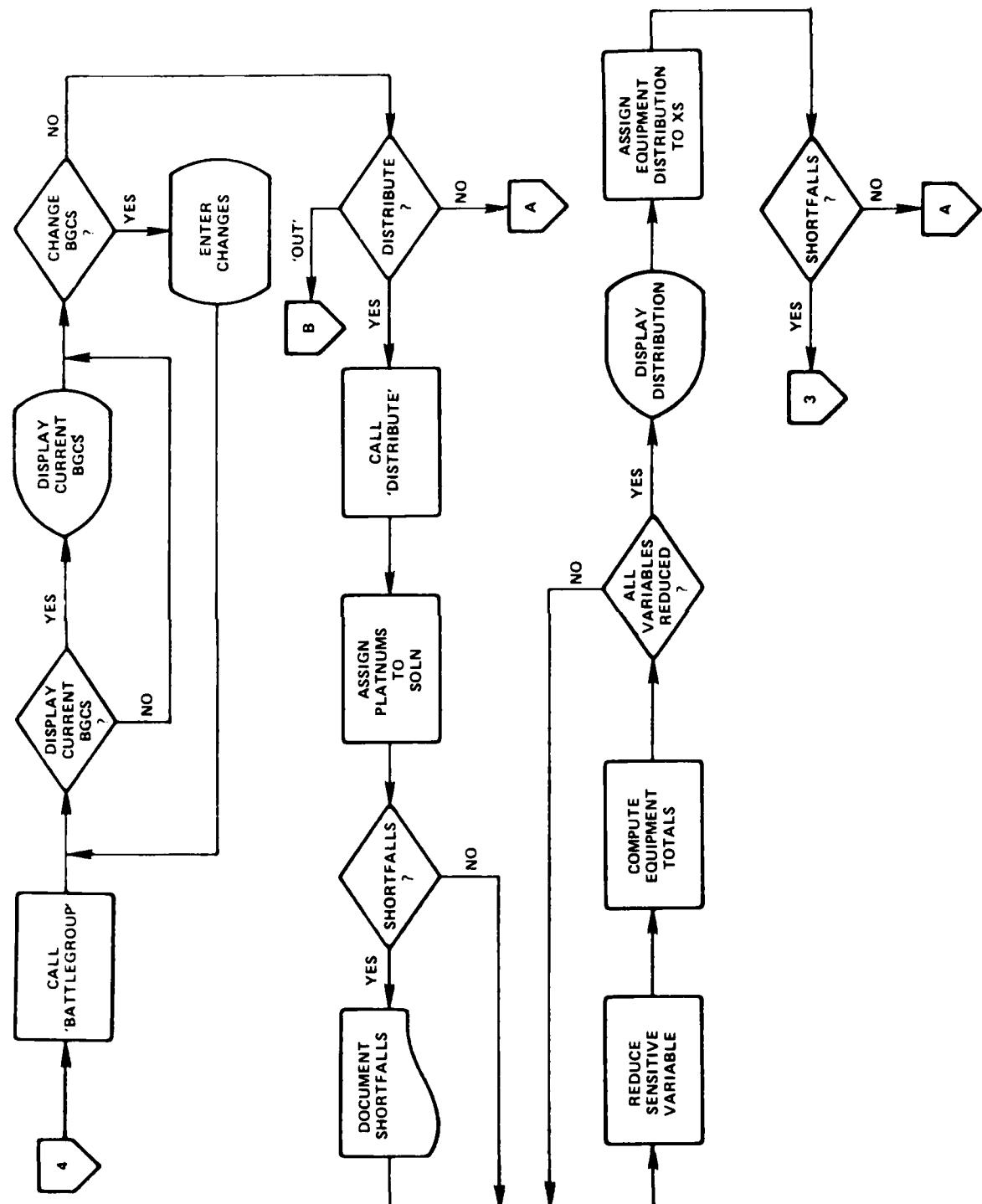


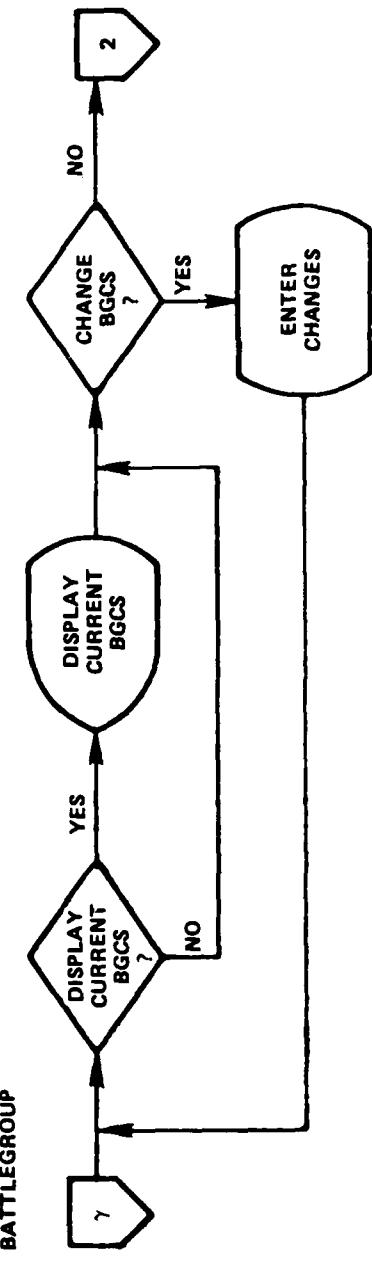
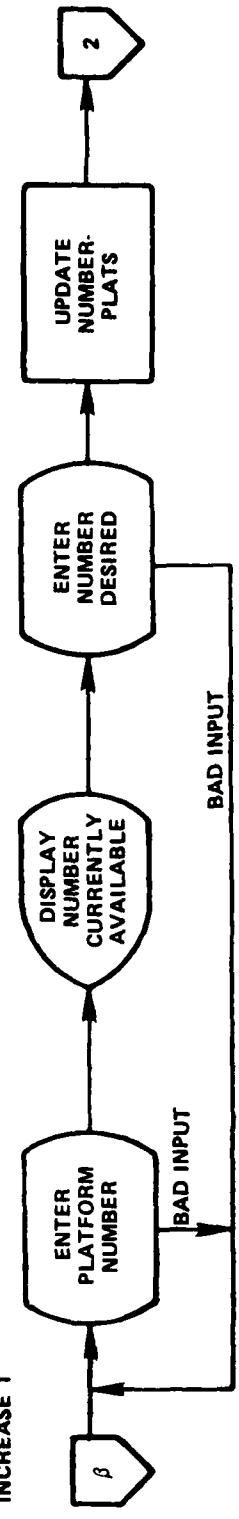
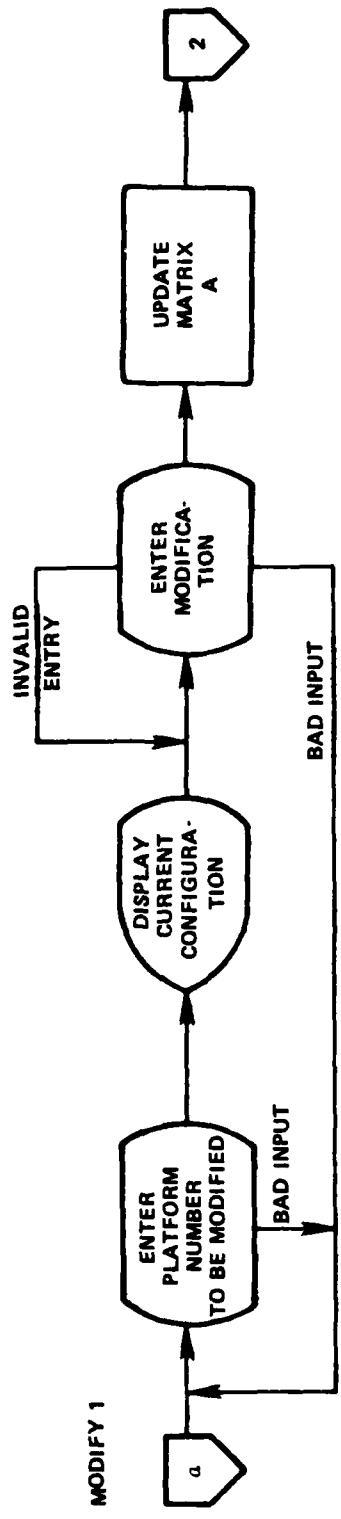
2. VIEW OR UPDATE CURRENT LOCAL DATA



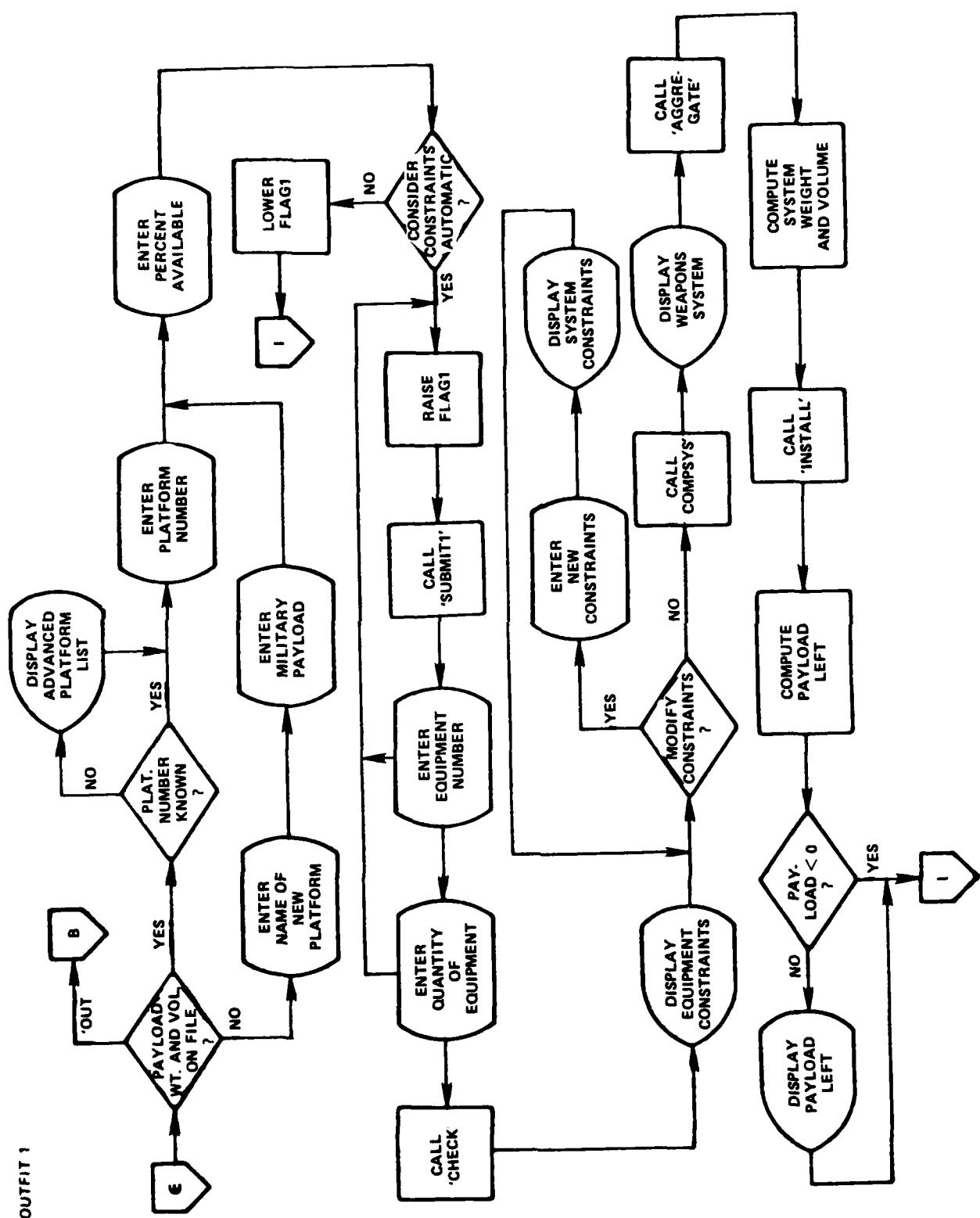


4 EXECUTE THE DISTRIBUTION ALGORITHM

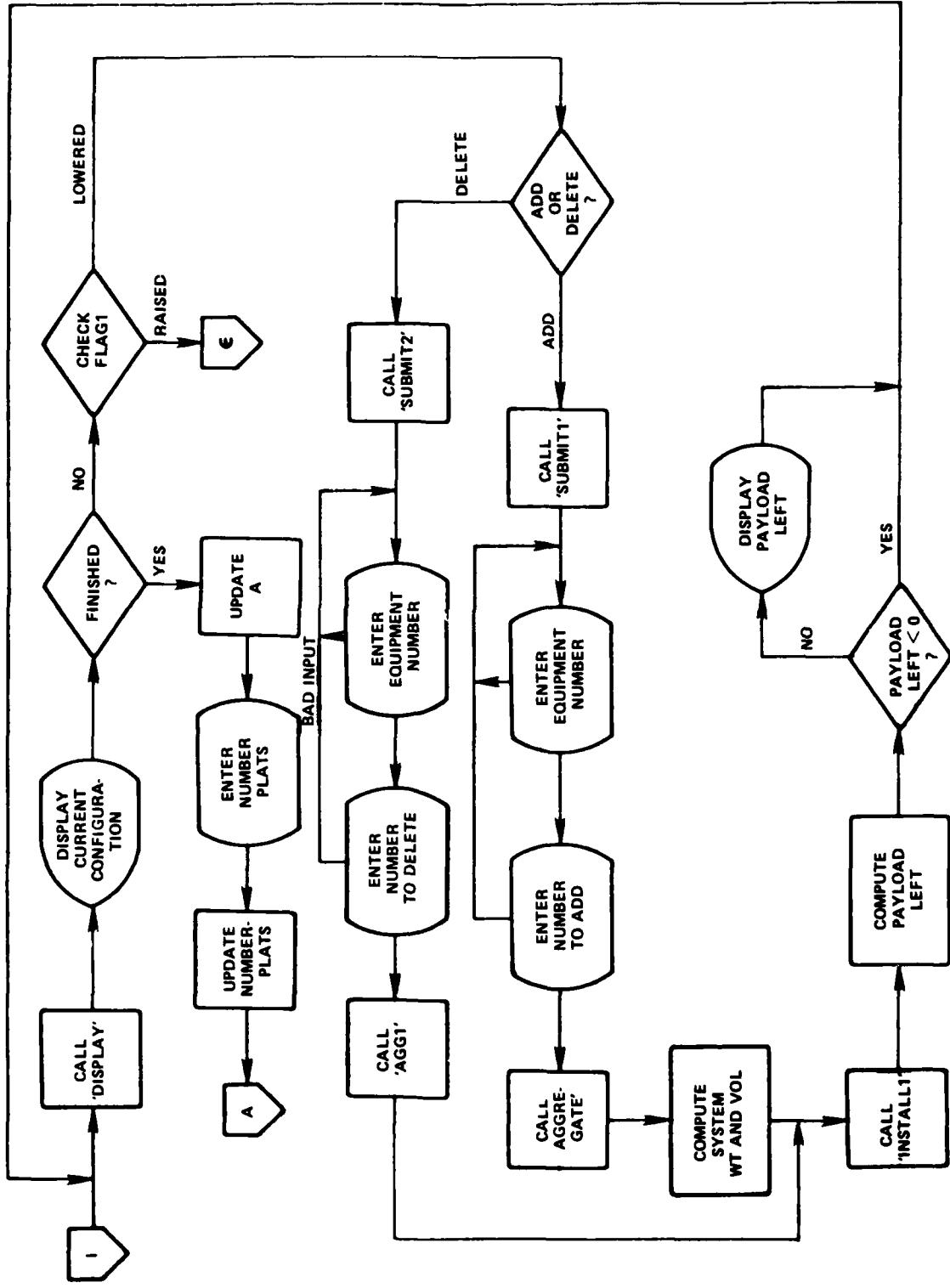




CONTENTS



MANUAL CONSTRAINTS



**APPENDIX E - TIDES INTERACTIVE SESSION**

RUN TIDES  
\$RUNNING 3005

```
*****  
* WELCOME TO TIDES *  
* THE INTERACTIVE DATA ENTRY SYSTEM *  
*  
* TODAY'S DATE IS 01/28/81 *  
* THE TIME IS 15:09 *  
* MOST RECENT WORK SESSION-01/28/81 *  
* AT 14:56 *  
*****
```

THIS PROGRAM HAS THE CAPABILITY TO:  
(1)CREATE A NEW DATA FILE NAMED TRY  
(2)EDIT AN ALREADY EXISTING FILE NAMED TRY

??

FILE OPTION?1

OPTION ONE, FILE CREATION MODE, REQUIRES A SAFETY CHECK  
TO INSURE THAT AN ALREADY EXISTING FILE NAMED TRY IS NOT WIPE OUT  
RE-ENTER FILE OPTION (BE SURE)?2

DO YOU ALREADY HAVE AN EQUIPMENT LIST FILE FOR PROGRAM(Y/N)?Y  
FOR A LISTING OF OPTIONS, TYPE 1 AFTER OPTION?

OPTION?1

THIS PROGRAM HAS THE FOLLOWING OPTIONS FOR DATA ENTRIES:

- (1) OPTION LIST
- (2) EQUIPMENT TYPE NUMBER LIST
- (3) EDIT EXISTING EQUIP. FILE: ADD, DELETE, OR MODIFY NAME
- (4) WEIGHT/VOLUME IN LBS & CU. FT.
- (5) DENSITY IN LBS/CU.FT.
- (6) PERCENT TOPSIDE WEIGHT AND VOLUME
- (7) TOPSIDE AND BELOW WEIGHT
- (8) TOPSIDE AND BELOW VOLUME
- (9) PRINT OUT A SPECIFIC UPDATED LINE
- (10) PRINT OUT UPDATED ARRAY
- (11) END

OPTION?2

( 1 )  
1)SPY-1

( 2 )  
2)SPS-40

( 3 )  
3)SPS-48C

( 4 )  
4)SPS-49

( 5 )  
5)SPS-55

( 6 )  
6)SPS-67

( 7 )  
7)MK-23TAS

( 8 )  
8)SQR-18

( 9 )  
9)SQR-19

( 10 )  
10)SLQ-25

( 11 )  
11)SLQ-32(V)2

( 12 )  
12)SLQ-32(V)3

( 13 )  
13)SQS-53 (W/ MK-116 FCS)

( 14 )  
14)SQS-56

( 15 )  
15)SSQ-72(OUTBOARD)

( 16 )  
16)SM-1(MR)

( 17 )  
17)SM-1(ER)

( 18 )  
18)SM-2(MR)

( 19 )  
19)SM-2(ER)

( 20 )  
20)NSSMS(W/MK 91 GMFCS)

( 21 )  
21)SLAT

( 22 )  
22)HARPOON(VA CELL CONTROLLER)

( 23 )  
23)HARPOON(ALONE)

( 24 )  
24)TOMAHAWK(4 CELL CANISTER LAUNCHER)

( 25 )  
25)TOMAHAWK(ALONE)

( 26 )  
26)MK-10 GMLS

( 27 )  
27)MK-11 GMLS

( 28 )  
28)MK-13 GMLS

( 29 )  
29)MK-16 RLS

( 30 )  
30)MK-36 DECOY LS

( 31 )  
31)EX-41 VLS

( 32 )  
32)MK-26 GMLS

( 33 )  
33)MK-15 CIWS

( 34 )  
34)MK-42 5"/54 GUN

( 35 )  
35)MK-45 5"/54 GUN

( 36 )  
36)MCLWG 8"/55

( 37 )  
37)MK-75 76mm GUN

( 38 )  
38)MK-32 SVTT

( 39 )  
39)ASROC

( 40 )  
40)MK-68 GIP MODS

( 41 )  
41)MK-74 GMFCS

( 42 )  
42)MK-76 GMFCS

( 43 )  
43)MK-86 GMFCS

( 44 )  
44)MK-92 GMFCS

( 45 )  
45)MK-99 GMFCS

( 46 )  
46)SEAFIRE

( 47 )  
47)A-6 INTRUDER

( 48 )  
48)S-3 VIKING

( 49 )  
49)E-2C HAWKEYE

( 50 )  
50)F-14 TOMCAT

( 51 )  
51)F-18 HORNET

( 52 )  
52)AV-8B HARRIER

( 53 )  
53)SH-3 SEA KING

( 54 )  
54)LAMPS I

( 55 )  
55)I AMPQ \*\*\*

OPTION?8

ENTER EQUIPMENT TYPE NUMBER?1  
EQUIPMENT TYPE:  
1)SPY-1

ENTER TOPSIDE VOL. AND BELOW VOL., SEPARATED BY COMMA?750,525  
TOTAL VOL. DOES NOT EQUAL SUM OF TOP & BEL. VOL'S. ENTERED  
DO YOU WISH TO OVERWRITE CURRENT SUM OF-646 (Y/N)?N

OPTION?9

ENTER EQUIPMENT TYPE NUMBER?1  
1)SPY-1  
47316 45934 1382 -646 -616 -30

OPTION?3

CHOOSE ADD, DELETE, OR MODIFY MODE (A/D/M)?M  
ENTER EQUIP. NUMBER TO BE MODIFIED?1  
ENTER NEW NAME-ONLY NAME CHANGES, NO CHANGE IN  
SPECIFICATIONS?AN/SPY-1  
1)SPY-1  
HAS BEEN CHANGED TO AN/SPY-1

OPTION?4

ENTER EQUIPMENT TYPE NUMBER?1  
EQUIPMENT TYPE:AN/SPY-1  
ENTER WEIGHT AND VOLUME, SEPARATED BY COMMA?48000,-650

OPTION?9

ENTER EQUIPMENT TYPE NUMBER?1  
AN/SPY-1 48000 45934 1382 -650 -616 -30

OPTION?20

EQUIP.	TOT. WT.	TOP/BEL.	TOT. VOL.	TOP/BEL
( 1 ) AN/SPY-1	48000	45934 / 1382 -650	-616 /-30	
( 2 ) 2)SPS-40	277000	45600 / 231400 -4134	-1134 /-3000	
( 3 ) 3)SPS-48C	169822	56400 / 113422 -782	-531 /-251	
( 4 ) 4)SPS-49	134731	19868 / 114863 -609	-314 /-295	
( 5 ) 5)SPS-55	165018	48853 / 116165 -1332	-804 /-528	
( 6 ) 6)SPS-67	2300	2300 / 0 -201	-201 / 0	

( 7 )				
7)MK-23TAS	143450	110600 / 32850 -2055	-1810 / -245	
( 8 )				
8)SQR-18	54000	42000 / 12000 1814	1302 / 512	
( 9 )				
9)SQR-19	17299	16537 / 762 1435	517 / 918	
( 10 )				
10)SLQ-25	21629	0 / 21629 -31	0 / -31	
( 11 )				
11)SLQ-32(V)2	4868	4168 / 700 -107	-94 / -13	
( 12 )				
12)SLQ-32(V)3	20015	7100 / 12915 -94	-50 / -44	
( 13 )				
13)SOS-53 (W/ MK-116 FCS)	39045	13350 / 25695 -1014	-314 / -700	
( 14 )				
14)SOS-56	16157	6190 / 9967 -640	-240 / -400	
( 15 )				
15)SSQ-72(OUTBOARD)	7280	1905 / 5375 -107	-50 / -57	
( 16 )				
16)SM-1(MR)	0	0 / 0 0	0 / 0	
( 17 )				
17)SM-1(ER)	0	0 / 0 0	0 / 0	
( 18 )				
18)SM-2(MR)	0	0 / 0 0	0 / 0	
( 19 )				
19)SM-2(ER)	0	0 / 0 0	0 / 0	
( 20 )				
20)NSSMS(W/MK 91 GMFCS)	0	0 / 0 0	0 / 0	
( 21 )				
21)SLAT	0	0 / 0 0	0 / 0	
( 22 )				
22)HARPOON(4 CELL CANISTER)	0	0 / 0 0	0 / 0	
( 23 )				
23)HARPOON(AI ONE)				

0	0 / 0	0	0 / 0
( 24 ) 24)TOMAHAWK(4 CELL CANISTER LAUNCHER)			
0	0 / 0	0	0 / 0
( 25 ) 25)TOMAHAWK(ALONE)			
0	0 / 0	0	0 / 0
( 26 ) 26)MK-10 GMLS			
0	0 / 0	0	0 / 0
( 27 ) 27)MK-11 GMLS			
0	0 / 0	0	0 / 0
( 28 ) 28)MK-13 GMLS			
0	0 / 0	0	0 / 0
( 29 ) 29)MK-16 RLS			
0	0 / 0	0	0 / 0
( 30 ) 30)MK-36 DECOY LS			
0	0 / 0	0	0 / 0
( 31 ) 31)EX-41 VLS			
0	0 / 0	0	0 / 0
( 32 ) 32)MK-26 GMLS			
0	0 / 0	0	0 / 0
( 33 ) 33)MK-15 CIWS			
0	0 / 0	0	0 / 0
( 34 ) 34)MK-42 5"/54 GUN			
0	0 / 0	0	0 / 0
( 35 ) 35)MK-45 5"/54 GUN			
0	0 / 0	0	0 / 0
( 36 ) 36)MCLWG 8"/55			
0	0 / 0	0	0 / 0
( 37 ) 37)MK-75 76mm GUN			
0	0 / 0	0	0 / 0
( 38 ) 38)MK-32 SVTT			
0	0 / 0	0	0 / 0
( 39 ) 39)ASROC			
0	0 / 0	0	0 / 0

( - 40 )				
40) MK-68 GIP MODS	0	0 / 0	0	0 / 0
( - 41 )				
41) MK-74 GMFCS	0	0 / 0	0	0 / 0
( - 42 )				
42) MK-76 GMFCS	0	0 / 0	0	0 / 0
( - 43 )				
43) MK-86 GMFCS	0	0 / 0	0	0 / 0
( - 44 )				
44) MK-92 GMFCS	0	0 / 0	0	0 / 0
( - 45 )				
45) MK-99 GMFCS	0	0 / 0	0	0 / 0
( - 46 )				
46) SEAFIRE	0	0 / 0	0	0 / 0
( - 47 )				
47) A-6 INTRUDER	0	0 / 0	0	0 / 0
( - 48 )				
48) S-3 VIKING	0	0 / 0	0	0 / 0
( - 49 )				
49) E-2C HAWKEYE	0	0 / 0	0	0 / 0
( - 50 )				
50) F-14 TOMCAT	0	0 / 0	0	0 / 0
( - 51 )				
51) F-18 HORNET	0	0 / 0	0	0 / 0
( - 52 )				
52) AV-8B HARRIER	0	0 / 0	0	0 / 0
( - 53 )				
53) SH-3 SEA KING	0	0 / 0	0	0 / 0
( - 54 )				
54) LAMPS I	0	0 / 0	0	0 / 0
( - 55 )				
55) LAMPS III	0	0 / 0	0	0 / 0

OPTIONS 11

**APPENDIX F - TIDES LISTINGS**

```

*FILE (CACK)TIDES ON DTNSRDC
100    REM      TIDES:THE INTERACTIVE DATA ENTRY SYSTEM
125    REM      WAS WRITTEN BY BOB QUILLIN IN JUNE
150    REM      OF 1980 AT DTNSRDC.  TIDES IS A DATA
175    REM      GATHERING TOOL THAT SUPPORTS THE AACD
200    REM      (ADVANCED AIRCRAFT CARRIER DEVELOPMENT) PROGRAM.
225    REM      TIDES IS CAPABLE OF STORING WEIGHTS AND
250    REM      VOLUMES INTO AN ARRAY, UPDATING AND EDITING
275    REM      AN ALREADY EXISTING ARRAY, COMPUTING TOPSIDE
300    REM      AND BELOW WEIGHTS AND VOLUMES, EMPLOYING DENSITY
325    REM      IN CALCULATIONS, AND PRINTING OUT THIS ARRAY.
330    REM      NOTE! TIDES WAS UPDATED IN JANUARY OF 1981 BY ITS
331    REM          ORIGINATOR, BOB QUILLIN.
340
350    REM      READ IN N=VERTICAL ARRAY LIMIT,B=HORIZONTAL ARRAY LIMIT
375    READ B
400    FILES HELP;EQUIP;TRY;INFO
425    INPUT #4,D$,I$
430
450    REM      A$ ARRAY=EQUIP, TYPES,B ARRAY-TEMP, MAIN DATA STORAGE
475    DIM A$(100),B(100,6)
480
500    REM      INTRODUCTION
525    PRINT TAB(20)******WELCOME TO TIDES*****
550    PRINT TAB(20)*          WELCOME TO TIDES          *
575    PRINT TAB(20)*          THE INTERACTIVE DATA ENTRY SYSTEM  *
590    PRINT TAB(20)*"TAB(58)"*
625    PRINT TAB(20)*          TODAY'S DATE IS "DAT$TAB(58)"*
650    PRINT TAB(20)*          THE TIME IS "TCLK$TAB(58)"*
675    PRINT TAB(20)*" MOST RECENT WORK SESSION-"D$TAB(58)"*
700    PRINT TAB(20)*"TAB(35)"AT " I$TAB(58)"*
725    PRINT TAB(20)******END*****"
750    PRINT
775    PRINT
780
800    REM      FILE OPTION CHOICE
825    PRINT "THIS PROGRAM HAS THE CAPABILITY TO: "
850    PRINT "      (1)CREATE A NEW DATA FILE NAMED TRY"
875    PRINT "      (2)EDIT AN ALREADY EXISTING FILE NAMED TRY"
890    PRINT "FILE OPTION";
925    INPUT L
950    IF L=2 GOTO 1125
960
975    REM      SAFETY FEATURE TO GUARD AGAINST FILE ANNIHILATION
1000   PRINT"OPTION ONE, FILE CREATION MODE, REQUIRES A SAFETY CHECK";
1025   PRINT"TO INSURE THAT AN ALREADY EXISTING FILE NAMED TRY IS NOT";
1050   PRINT " WIPE OUT"
1075   PRINT"RE-ENTER FILE OPTION (BE SURE)";
1100   INPUT L
1105
1110   REM      OPTION TO USE OLD EQUIP. LIST OR CREATE NEW ONE
1125   PRINT "DO YOU ALREADY HAVE AN EQUIPMENT LIST FILE FOR PROGRAM";
1150   PRINT "(Y/N)";
1175   INPUT C$
1200   N=0
1225   IF C$="Y" GOTO 1550
1230
1240   REM      SAFETY CHECK GUARDING AGAINST FILE LOSS
1250   PRINT "BE CAREFUL, IF EQUIPMENT FILE ALREADY EXISTS, IT";
1275   PRINT "WILL BE OVERWRITTEN. TO BE SAFE, RE-ENTER ANSWER:";
1300   PRINT "DOES AN EQUIPMENT LIST EXIST (Y/N)?"

```

```

1325      INPUT C$
1350      IF C$="Y" GOTO 1550
1360
1370      REM EQUIP. NAME ENTRY MODE
1375      PRINT "ENTER EQUIPMENT TYPES, ONE AT A TIME";
1400      PRINT "(TYPE STOP WHEN FINISHED),";
1425      INPUT E$
1450      IF E$="STOP" GOTO 1625
1475      N=N+1
1500      A$(N)=E$
1525      GOTO 1425
1550      N=N+1
1575      INPUT #2,A$(N)
1600      IF MORE #2 THEN 1550
1625      IF L=2 GOTO 2025
1640
1650      REM **** FILE CREATION MODE ****
1675      REM INITIALIZE D ARRAY WITH ALL ELEMENTS EQUAL TO ZERO
1700      FOR I=1 TO N
1725      FOR J=1 TO 6
1750      D(I,J)=0
1775      NEXT J
1800      NEXT I
1805
1825      REM PRINT D ARRAY (ALL ZEROS) INTO TRY (CREATION MODE)
1850      SCRATCH #3
1875      FOR I=1 TO N
1900      PRINT #3,D(I,1),D(I,2),D(I,3),D(I,4),D(I,5),D(I,6)
1925      NEXT I
1950      REM SKIP EDIT MODE STEPS AND MOVE ON
1975      GOTO 2150
1981
2000      REM **** FILE EDIT MODE ****
2025      REM COPY TRY INTO ARRAY D
2050      FOR I=1 TO N
2075      INPUT #3,D(I,1),D(I,2),D(I,3),D(I,4),D(I,5),D(I,6)
2100      NEXT I
2125      RESTORE #3
2140
2150      REM OPTION CHOICE
2175      PRINT "FOR A LISTING OF OPTIONS, TYPE 1 AFTER OPTION?"
2200      PRINT
2225      PRINT "OPTION";
2250      INPUT F
2275      PRINT
2290
2300      REM SENDS PROGRAM TO FOLLOWING LOCATIONS, ACCORD. TO OPTION
2325      ON F GOTO 2350,2675,2775,3525-3525,3525,3525,3525,5225,5500
2340
2345      REM OPTION LIST
2350      PRINT "THIS PROGRAM HAS THE FOLLOWING OPTIONS FOR DATA ENTRIES:"
2375      PRINT "      (1) OPTION LIST"
2400      PRINT "      (2) EQUIPMENT TYPE NUMBER LIST"
2420      PRINT TAB(7)*(3) EDIT EXISTING EQUIP. FILE; ADD, DELETE, OR*
2422      PRINT " MODIFY NAME"
2425      PRINT "      (4) WEIGHT/VOLUME IN LBS & CU. FT."
2450      PRINT "      (5) DENSITY IN LBS/CU.FT."
2475      PRINT "      (6) PERCENT TOPSIDE WEIGHT AND VOLUME"
2500      PRINT "      (7) TOPSIDE AND BELOW WEIGHT"
2525      PRINT "      (8) TOPSIDE AND BELOW VOLUME"
2550      PRINT "      (9) PRINT OUT A SPECIFIC UPDATED LINE"
2575      PRINT "      (10) PRINT OUT UPDATED ARRAY"
2600      PRINT "      (11) END"
2625      GOTO 2200
2640
2650      REM PRINT OUT EQUIP. TYPES

```

```

2675 FOR I=1 TO N
2700 PRINT "(I) " ;A$(I)
2702 PRINT
2725 NEXT I
2750 GOTO 2200
2760
2770 REM EQUIP. LIST EDIT MODE
2775 PRINT "CHOOSE ADD, DELETE, OR MODIFY MODE (A/D/M)" ;
2800 INPUT D$
2825 IF D$="D" GOTO 3225
2830 IF D$="M" GOTO 3480
2844
2845 REM NAME INSERTION
2850 PRINT "ENTER EQUIPMENT TYPE NAME";
2875 INPUT N$
2900 PRINT "ENTER NUMBER WHERE EQUIP. TYPE IS TO BE INSERTED";
2925 INPUT N1
2950 FOR I=N TO N1 STEP -1
2975 A$(I+1)=A$(I)
3000 FOR J=1 TO B
3025 D(I+1,J)=D(I,J)
3050 NEXT J
3075 NEXT I
3100 A$(N1)=N$
3125 FOR I=1 TO B
3150 D(N1,I)=0
3175 NEXT I
3180 N=N+1
3200 GOTO 2200
3210
3215 REM NAME DELETION
3225 PRINT "ENTER EQUIP. NUMBER YOU ARE DELETING";
3250 INPUT E1
3275 PRINT A$(E1) " DELETED"
3300 FOR I=E1 TO N
3325 A$(I)=A$(I+1)
3350 FOR J=1 TO B
3375 D(I,J)=D(I+1,J)
3400 NEXT J
3425 NEXT I
3450 N=N-1
3475 GOTO 2200
3476
3477 REM NAME MODIFICATION
3480 PRINT "ENTER EQUIP. NUMBER TO BE MODIFIED";
3482 INPUT N2
3484 PRINT "ENTER NEW NAME-ONLY NAME CHANGES, NO CHANGE IN "
3486 PRINT "SPECIFICATIONS";
3488 INPUT N$
3490 PRINT A$(N2) " HAS BEEN CHANGED TO "N$
3492 A$(N2)=N$
3494 GOTO 2200
3496
3500 REM CHOOSE EQUIP. TYPE YOU ARE WORKING WITH
3525 PRINT "ENTER EQUIPMENT TYPE NUMBER";
3550 INPUT T
3575 IF P=9 GOTO 3625
3600 PRINT "EQUIPMENT TYPE:"A$(T)
3625 ON P GOTO 2350,2675,2775,3675,3825,4725,4100,4400,4950,5225,5500
3627
3650 REM WEIGHT AND VOLUME
3675 PRINT "ENTER WEIGHT AND VOLUME, SEPARATED BY COMMA";
3700 INPUT W,V
3725 D(T,1)=INT(W+.5)
3750 D(T,4)=INT(V+.5)
3775 GOTO 2200

```

```

3780
3800    REM DENSITY W/PRIORITIES "1"=WT. CONSTANT,"2"=VOL. CONSTANT
3825    PRINT"ENTER DENSITY FOLLOWED BY 1 FOR WT., 2 FOR VOL. PRIORITIES"
3850    INPUT Y,R
3875    IF R=2 GOTO 3975
3900    D(T,4)=INT((D(T,1)/Y)+.5)
3925    IF D(T,5)+D(T,6)<>D(T,4) GOTO 4050
3950    GOTO 2200
3975    D(T,1)=INT((D(T,4)*Y)+.5)
4000    IF D(T,2)+D(T,3)<>D(T,1) GOTO 4050
4025    GOTO 2200
4050    PRINT"WARNING-TOP & BEL. CALCULATIONS ARE NOW NOT ACCURATE W/ TOTAL"
4075    GOTU 2200
4080
4099    REM TOPSIDE AND BELOW WEIGHT CALAULATIONS
4100    PRINT "ENTER TOPSIDE WT. AND BELOW WT., SEPARATED BY COMMA'S"
4125    INPUT E,O
4150    IF D(T,1)=0 GOTO 4300
4175    IF D(T,1)=E+O GOTO 4300
4200    PRINT"TOTAL WT. DOES NOT EQUAL SUM OF TOP & BEL. WTS. ENTERED"
4225    PRINT"DO YOU WISH TO OVERWRITE CURRENT SUM OF";D(T,1);"(Y/N)"?
4250    INPUT L$
4275    IF L$ = "N" GOTO2200
4300    D(T,2)=E
4325    D(T,3)=O
4350    D(T,1)=E+O
4375    GOTO 2200
4380
4390    REM TOPSIDE AND BELOW VOLUME ENTRY
4400    PRINT "ENTER TOPSIDE VOL. AND BELOW VOL., SEPARATED BY COMMA'S"
4425    INPUT M,X
4450    IF D(T,4)=0 GOTO 4600
4475    IF D(T,4)=M+X GOTO4600
4500    PRINT"TOTAL VOL. DOES NOT EQUAL SUM OF TOP & BEL. VOLS. ENTERED"
4525    PRINT"DO YOU WISH TO OVERWRITE CURRENT SUM OF";D(T,4);"(Y/N)"?
4550    INPUT M$
4575    IF M$ = "N" GOTO 2200
4600    D(T,5)=M
4625    D(T,6)=X
4650    D(T,4)=M+X
4675    GOTO 2200
4680
4700    REM PERCENTAGE WEIGHT AND VOLUME SPECIFICATIONS
4725    PRINT "ENTER PERCENT TOPSIDE WEIGHT, IN DECIMAL FORM"
4750    INPUT P
4775    D(T,2)=INT((D(T,1)*P)+.5)
4800    D(T,3)=INT((D(T,1)*(1-P))+.5)
4825    PRINT "ENTER PERCENT TOPSIDE VOLUME, IN DECIMAL FORM"
4850    INPUT Q
4875    D(T,5)=INT((D(T,4)*Q)+.5)
4900    D(T,6)=INT((D(T,4)*(1-Q))+.5)
4925    GOTO 2200
4930
4945    REM PRINT OUT ONE SPECIFIC LINE "T"
4950    PRINT A$(T),D(T,1),D(T,2),D(T,3),D(T,4),D(T,5),D(T,6)
4975    GOTO 2200
4980
5225    REM PRINT OUT ENTIRE ARRAY
5250    PRINT "EQUIP.",, "TOT. WT.",, "TOP/BEL.",, "TOT. VOL.",, "TOP/BEL"
5252    PRINT
5275    FOR I=1 TO N
5300    PRINT "("I")"
5325    PRINT A$(I)TAB(16)D(I,1)TAB(31)D(I,2)"/"D(I,3)TAB(46)D(I,4)TAB(61)
5350    PRINT D(I,5)"/"D(I,6)
5352    PRINT
5375    NEXT I

```

```
5380      GOTO 2200
5400
5500      REM   TIME AND DATE WRITTEN INTO STORAGE
5525      SCRATCH #4
5530      SCRATCH #2
5534      SCRATCH #3
5550      D$=DAT$
5575      I$=CLK$
5600      PRINT #4,D$,";I$",""
5601
5602      REM   PRINT ALL ARRAY D ELEMENTS INTO TRY
5604      FOR I=1 TO N
5606      PRINT #2,A$(I);","
5608      PRINT#3,D(I,1)",";D(I,2)",";D(I,3)",";D(I,4)",";D(I,5)",";D(I,6)
5610      NEXT I
5615
5620      REM   DATA FOR VERTICAL AND HORIZONTAL BOUNDS
5624      DATA 6
5640
9999      END
*
```

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